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The Heating and Ventilating Magazine

Vol. XXII No. 1

Contents for January, 1925

The Insulation of Roofs to Prevent Heat Loss and Condensation.....*W. L. Miller* 49

Home-Study Course in Gravity Steam and Water Heating..... 52
Lesson No. 3—Heat Loss Computations.

Back to First Principles.....*T. W. Reynolds* 57
Circulating Water Below Its Heating Source Without Mechanical Means.

A Short, Practical Method of Designing Gravity Water Heating Systems
F. E. Giesecke 60
VII—The Design of a One-Pipe System with Overhead Distribution and Reversed Return.

National Warm-Air Heating and Ventilating Association..... 69
Warm-Air Furnace Men Dedicate Their Heating Research Residence.

American Society of Heating and Ventilating Engineers..... 72
Ontario Chapter Discusses Oil Burning.
Group Engineering of Grand Central Terminal Described to New York Chapter.
Massachusetts Chapter.
Nomination of Samuel E. Dibble for President.
Tentative Program for Annual Meeting.

The Weather for November, 1924..... 76
New York, Boston, Pittsburgh, Chicago and St. Louis.

Correspondence..... 78
Extending the Vacuum to the Inside of the Radiator.
Effect of Room Partitions in Figuring Radiation.
Experience in Burning Buckwheat in a House Heater.
Ventilating Vagaries.

Legal Decisions..... 80
Schedule of Electric Heating Rates Increase.
Patent for Thermostatic Control of Dampers Held Invalid as Previously Dedicated to Public Use.

Building Contracts, By Classes,, 1919–1924..... 80

Dominion Fuel Board Issues Report on Central Heating..... 80

National Trade Extension Bureau..... 81
Heating and Plumbing Sales.
Accounting of the Contractor.

Recommended Procedure for Selecting General Contractors and Sub-Contractors.. 82

Points to Remember in Selecting Vacuum Cleaning Apparatus.....*C. H. Whiting* 83

New Publications..... 84
Important Data on Heat Transmission of Insulating Materials.

How to Heat Your Home.....*Samuel S. Wyer* 87
IV.—How to Burn Bituminous Coal.

The State of Business.....*L. W. Alwyn-Schmidt* 88
Spring Business Promises Well.

Standard Heating and Ventilating Data Sheets..... 94
No. 14-BB—Radiator Ratings—1-in. Pipe Coil, Concealed, Two Top Registers.
No. 14-CC—Radiator Ratings—1¼-in. Pipe Coil, Concealed, Two Top Registers.
No. 14-DD—Radiator Ratings—1½-in. Pipe Coil, Concealed, Two Top Registers.
No. 14-EE—Radiator Ratings—2-in. Pipe Coil, Concealed, Two Top Registers.

Engineers' Specification Index, Page 134

Advertisers' Index, Page 142

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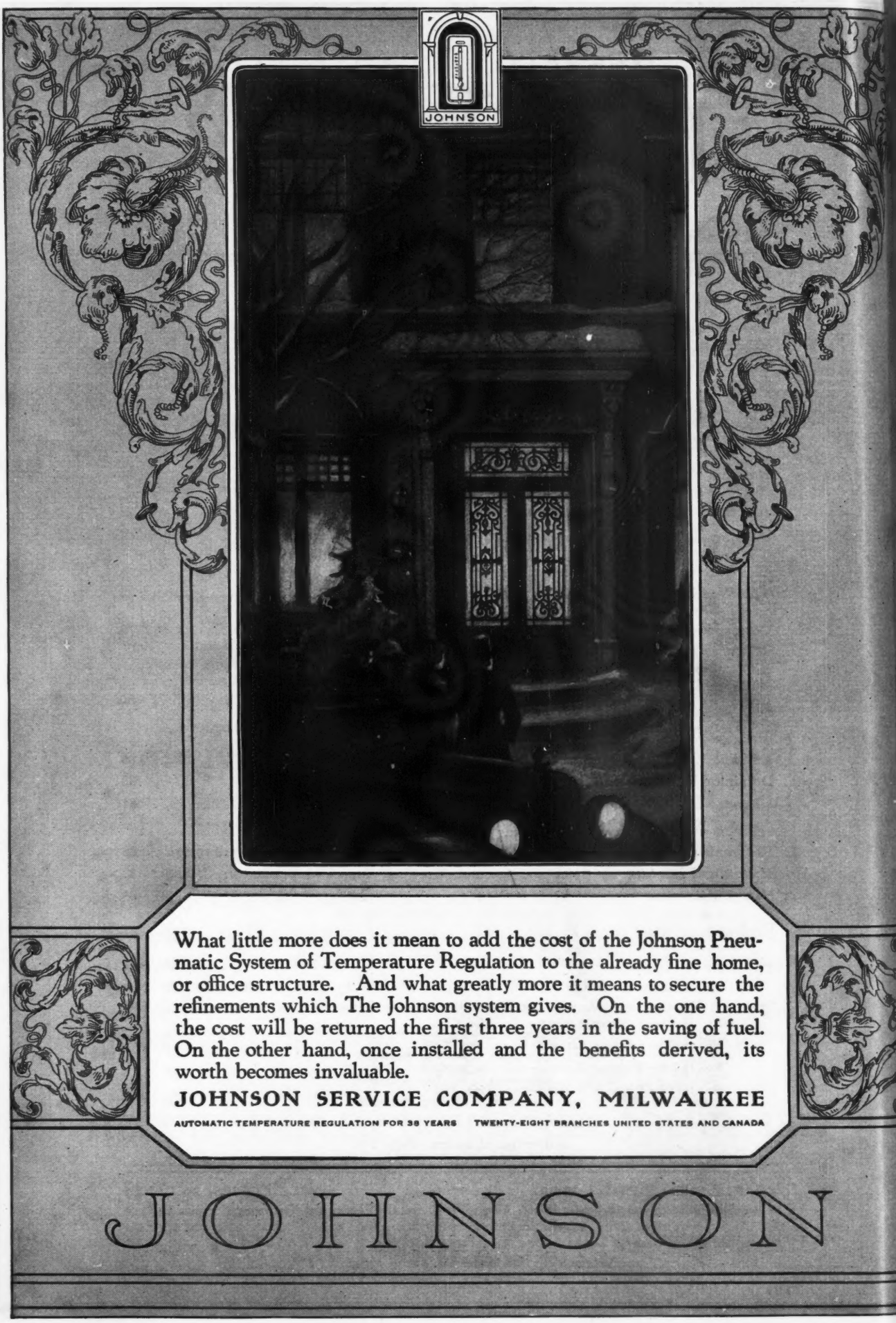

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The Heating and Ventilating Magazine

A Monthly Journal of Engineering Progress.

JANUARY, 1925

The Insulation of Roofs to Prevent Heat Loss and Condensation

With Important New Chart for Figuring, in One Operation, the Necessary Roof Resistance for Any Humidity to Prevent Condensation, Heretofore Requiring Separate Psychrometric Chart

By W. L. Miller

Vice-president and General Manager, Union Fibre Company, Inc.

HAVING established a method of calculating the heat loss through any roof (see THE HEATING AND VENTILATING MAGAZINE for November, 1924), we can now proceed with the problem of preventing condensation.

To do this it is necessary to keep the temperature of the inside surface of the roof above the dew point for the outside air, the temperature at which condensation will occur for air of known humidity in the building. We must, therefore, have some method of determining the relation between the temperature of the inside surface of the roof and the temperature of the air in the room, as condensation depends upon this difference in temperature.

One of the fundamental formulas of heat transmission is

$$H = K_1 (t - t_1) \quad \ldots\ldots\ldots\ldots \quad (1)$$

where H = amount of heat transmitted through the roof.

K_1 = surface coefficient, or surface conductivity in B.T.U. per square foot per degree difference in temperature, per hour.

t = temperature of air inside of building, immediately beneath the roof.

t_1 = temperature of inner surface of roof.

The general procedure followed herein for the determination of the proper thickness of insulation on any roof to prevent condensation is as follows:

Determine.

1. Humidity of air under roof.

2. Temperature of inside and outside air at time of minimum outside temperature.

With the above conditions, the heat head is the difference in degrees between the inside and outside temperature. Proceeding from this point, determine:

3. From Table No. 1 (see The Heating and Ventilating Magazine for November, 1924) the resistance of the particular kind of roof uninsulated.

4. From the accompanying Resistance and Humidity Curves, the necessary total resistance for the roof, to prevent condensation.

5. The additional resistance to be applied to the uninsulated roof.

6. The necessary thickness of the particular insulation to be applied.

The factor $(t - t_1)$ is therefore the difference in temperature between the air in the building and the inner surface of the roof, which is what we must know to prevent condensation on the inner roof surface. We require this information in the form of a relation showing the amount of heat transmitted through the roof per degree difference in temperature between the air in the building and the inner surface of the roof.

By transposing equation (1),

$$\frac{H}{K_1} = (t - t_1) \quad \ldots\ldots\ldots\ldots \quad (2)$$

Then for a difference of 1 degree, or $(t - t_1) = 1$, we have:

$$H/K_1 = 1, \text{ or } \ldots\ldots\ldots\ldots\ldots \quad (3)$$

$$H = K_1 \quad \ldots\ldots\ldots\ldots\ldots \quad (4)$$

If $H = K_1$, then the heat transmitted through the roof per degree difference in temperature between that of the air in the building and that of the inner surface of the roof, is equal to the surface coefficient of conductivity for the material which constitutes this inner roof surface.

Table 3, reproduced from the earlier article, shows the surface coefficients and surface resistances for various materials.

TABLE 3. SURFACE COEFFICIENTS (STILL AIR).

	Conductivity	Resistance	Authority
Brick wall	1.40	0.714	Univ. Ill.
Cement (plaster finished)	0.93	1.075	Univ. Ill.
Concrete	1.30	0.769	Univ. Ill.
Wood, fir (one surface finished)	1.40	0.714	Univ. Ill.
Corkboard	1.25	0.800	Univ. Ill.
Magnesia Board	1.45	0.789	Univ. Ill.
Glass window	1.50	0.666	Univ. Ill.
Glass (window)*	1.90	0.526	Univ. Pa.
Glass (actual glass 91.4% of total area)	2.00	0.500	Univ. Ill.
Glass (double ½ in. air space. Glass 69.3% of total area)	2.00	0.500	Univ. Ill.
Tile, plastered on both sides	1.10	0.909	Univ. Ill.
Asbestos board	1.60	0.625	Univ. Ill.
Sheet asbestos	1.40	0.714	Univ. Ill.
Roofing	1.25	0.800	Univ. Ill.
Iron	1.20	0.833	Univ. Ill.
Building Paper	1.40	0.714	Univ. Pa.

* Average of both sides of glass 0.12 in. thick and for 70° F., total temperature difference from air to air with moving air on one side. Probable values for still air on both sides, 1.60.

EXPLANATION OF ROOF RESISTANCE AND HUMIDITY CURVES

The most desirable method of tabulating data is in the form of a curve, where all known factors are so plotted that the desired unknown factor may be read off immediately without any computation whatever. With this in mind, the resistance and conductivities of all roofs of ordinary construction without insulation were calculated and are arranged in Table 1, which appeared in THE HEATING AND VENTILATING MAGAZINE for November, 1924.

The accompanying Roof Resistance and Humidity Curves (Fig. 3) were then developed in the following manner:

The scales on the left for Heat Head and Relative Humidity, on the right for Resistance and at the bottom, for Difference in Temperature (allowable temperature drop) are self explanatory. The Humidity Curve was made by plotting per cent. relative humidities against degrees temperature allowable drop to dewpoint, as follows:

Per Cent. Relative Humidity	Degrees F. Allowable Drop
100	0.1
90	3.0
80	6.5
70	10.5
60	14.5
50	19.5
40	25.5
30	32.5
25	37.0
20	43.0

The Conductivity plotted on the top line is on the basis of 1.35 B.T.U. per degree difference in temperature shown on the bottom line of the chart. This is for the reason that the amount of heat transmitted through a roof per degree difference in temperature between the air in the building and the inner roof surface is equal to the surface constant of the inner roof material. The usual materials on the inside of a roof are concrete and wood. The surface constant for concrete (see Table 3) is 1.3 and for wood, 1.4. It has been assumed from this that the average surface constant for the inside material will be 1.35.

The Resistance Curve was obtained as follows:

It was shown in Table 1 that the conductivity of Roof No. 1 (⅞-in. boards, soft pine, fir, spruce, etc.) uninsulated, was 0.382 B.T.U. Assuming a heat head of 100°, the total heat loss per square foot per hour would then be 0.382 x 100, or 38.2 B.T.U. Then on the horizontal line of 100° heat head, we locate a point at 38.2 B.T.U. to the right, by the scale on the top line of the chart. Through this point the line No. 1 is drawn, which is the line of heat loss of a roof of that particular resistance for different heat heads. The heat loss through this roof, for any particular heat head, can be found by reading vertically upward from the intersection of Line No. 1 with the horizontal line of the heat head in question, and reading the heat loss in B.T.U. per hour on the scale at the top of the chart.

The resistance of Roof No. 1 is $1/0.382 = 2.616$. By means of the scale on the right-hand side of the chart, a resistance of 2.616 is measured upward and a point located on the line marked No. 1. This is the resistance point for that roof.

In a similar manner, lines were laid out for a number of different roofs and the resistance point located on each roof line, although on the chart here reproduced only the lines for Roof No. 1 (⅞-in. boards, soft pine, fir, spruce, etc.) and for Roof No. 14 (6-in. boards, soft pine, fir, spruce, etc.) are shown.

The Resistance Curve (a straight vertical line) was obtained by drawing the line RR through all of these resistance points.

USE OF THE RESISTANCE AND HUMIDITY CHART

It is possible, by means of a sling psychrometer, or a wet and dry bulb thermometer outfit, to measure the relative humidity of the air in a building or experience will permit one to judge what humidity may be expected.

The following example will illustrate the method of using the Resistance and Relative Humidity Curves to determine the amount of insulation that must be applied to a roof to prevent condensation, when the relative humidity of the air in the building is known or from experience can be fairly well approximated.

Example: 5-ply tar and gravel roofing on 6-in. concrete slab.

Inside humidity—40% relative humidity.

Temperatures:

Inside, 70°.

Outside, —30°.

Heat head, 100°.

(*Continued on Page 67*)

A Chart for Calculating Quickly, in One Operation, the Required Roof Resistance to Prevent Condensation on Lower Side of Roof.

(*With any Relative Humidity Inside and For Any Type of Roof*)

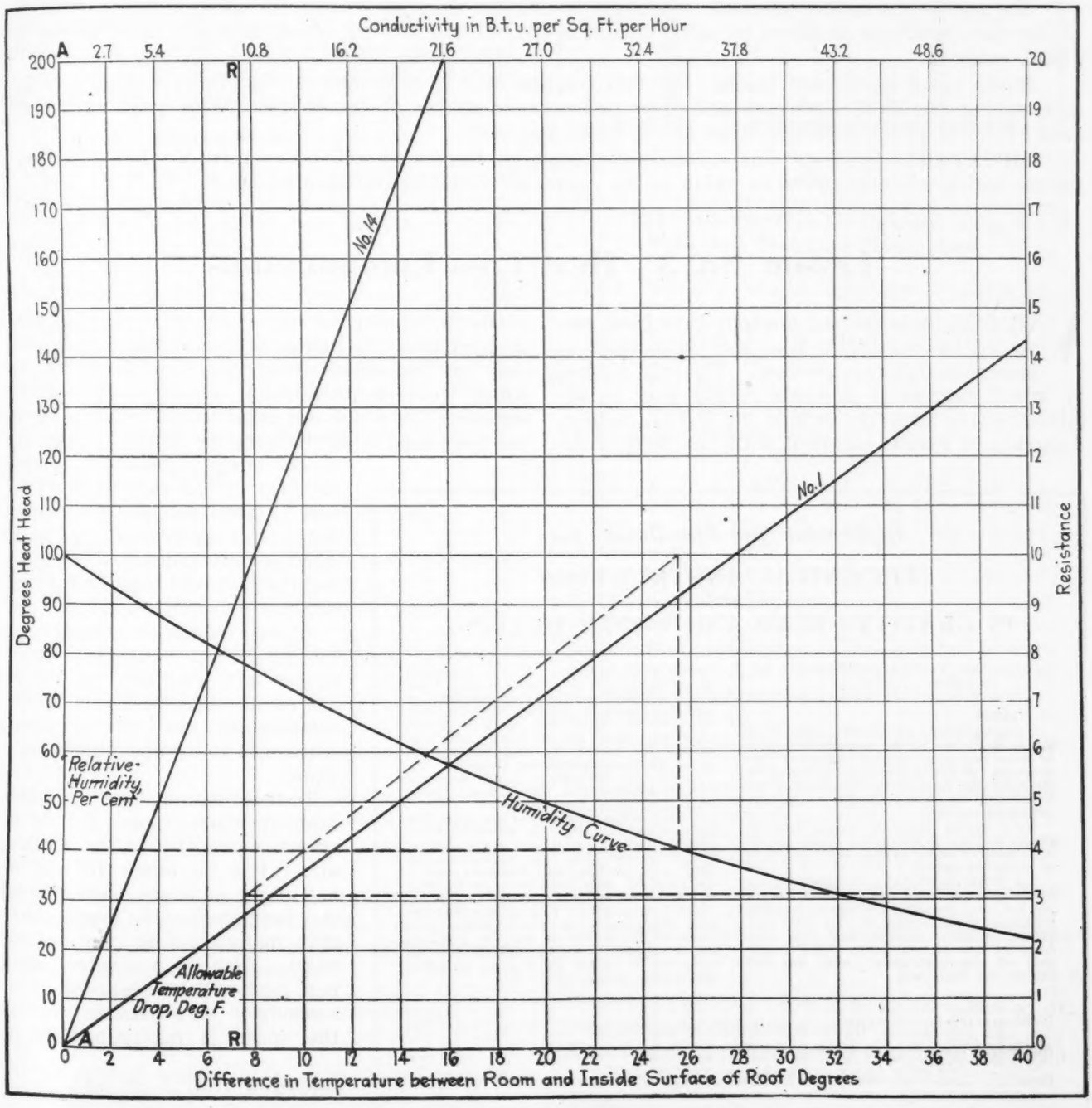
A unique feature of the accompanying Roof Resistance and Humidity Chart is that by the use of the curves plotted on it, the need of working from a psychrometric chart is obviated, and any problem can be solved within a few minutes. The curves are based upon 70° F. inside temperature; however, with but slight error they can be used for inside temperatures between 50° and 90° F.

Example: To determine the necessary amount of roof resistance to prevent condensation with an inside temperature of 70° F., outside temperature—30° F., giving a heat head of 100°, with the inside relative humidity 40%, we start at the left vertical scale of 40% relative humidity and follow horizontally to the right to the intersection with the Humidity Curve. Then follow vertically up to the intersection with the horizontal degree heat head line of the problem, which is 100°. Now, from the intersection draw a line through the lower left-hand corner of the chart or "zero" and note the crossing point of the curve RR. Then read horizontally to the right the resistance (approximately 3.0) which is the total roof resistance required to prevent precipitation on the under side of the roof.

This problem can be reversed as follows:

Given a roof with a resistance of 3.0, what is the greatest relative humidity that can be carried under the roof with a heat head of 100° before condensation will occur at a room temperature of 70°?

On the Roof Resistance Curve RR locate a point at a height of 3.0 by the resistance scale on the right-hand side of the chart. Draw a line from this point through the lower left-hand corner A. Where this line intersects the horizontal line of 100° heat head, read vertically downward to the humidity curve on the chart. Then pass horizontally to the left-hand edge of the chart where we find that the roof will support a relative humidity of approximately 40% maximum, at 70° temperature.



Roof Resistance and Relative Humidity Chart

This is the third lesson of

The Heating and Ventilating Magazine's

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Instruction is available only to subscribers of THE HEATING AND VENTILATING MAGAZINE. The first lesson appeared in November, but you can commence the course any time. As soon as your enrollment is received, Lesson 1 will be sent to you, if you have not already received it, together with the Work Problems pertaining to Lesson 1. Full directions will be included as to where to send your solutions of the Work Problems.

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(6) I agree on my part to prosecute the work energetically, to devote regular time to study (in so far as may be possible) and to complete it without delay unless interference is caused by sickness or other unavoidable causes.

Name.....

Address.....

Date..... Accepted.....

Lesson No. 3 Heat Loss Computations

VARIOUS formulas and methods have been presented for calculating heat loss upon which to base radiation requirements. The only method by which nearest to accurate results may be obtained is very properly termed the B.T.U. method. Accuracy of results obtained with this method depends principally on the accuracy of the designer in computing the areas of the surfaces and how close the transmission factor used agrees with that which would be obtained if a section of the construction for which computations were being made had been used in determining the factor. Since this is obviously impossible, factors, as given in Tables 4 to 12 (Lesson 2) and developed for a similar type of construction are used, although the materials composing the test wall might have had slightly different characteristics.

It was explained in Lesson 1 how the heat contained in a warm object will gradually be transferred to one having a lower temperature until the temperatures of the two objects are equal.

In this manner, heat will pass from a warm room, (a) to a colder room, (b) to the outside air, (c) to the attic, (d) and to any other adjacent space where the temperature is lower than that maintained in the heated room. Also, in a similar manner, heat will be absorbed by a room from an adjacent space if the space is maintained at a

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higher temperature than the room. Consequently, in calculating heat loss for upper story rooms having cold attics above, the loss through the ceiling should always be considered. In like manner, heat calculation losses for rooms with unheated space under them should always include the loss through the floor.

Therefore, to obtain the net B.T.U. loss for a heated room, all surfaces or constructions that separate the room from a space in which the temperature is lower than in the room are counted as positive heat losses and all surfaces or constructions that separate the room from a space in which the temperature is higher than in the room are counted as negative heat losses. The algebraic sum of all positive and negative heat losses will be the net B.T.U. loss from the room without consideration of exposure.

An exposure factor should be included in all calculations for outside walls, windows and doors. It need not be considered when figuring for inside walls, windows, doors, ceilings or floors.

APPLICATION OF B.T.U. METHOD

Fig. 7 represents a typical room by the use of which the application of the B.T.U. method of computing heat loss calculations may be clearly understood.

It is assumed that the temperature in room A is to be maintained at 70° F. and that the net heat loss therefrom in B.T.U. per hour is desired. Space Y represents outside air space, minimum temperature, zero deg. F.; B and C are adjoining rooms, temperature of B, 60° F., temperature of C, 65° F.; space X represents a hall at 40° F. Dimensions of the walls, windows and doors and the other conditions are as follows:

D = 30 ft.; E = 22 ft.

K = 12-in. brick wall, plastered inside, (see Table 4).

H = Stud partition, lath and plaster both sides, (see Table 12).

J = Windows, 4 ft. × 5 ft. openings, wood frame, single glass (see Table 9).

M = Door, 4 ft. × 7 ft., 1⅜ in. thick (see Table 10).

Ceiling, 10 ft. high, lath and plaster on joists. (see Table 7) (attic above unheated).

Floor, 1½ in. thick on sleepers laid on the ground, (see Table 6).

Disregard windows J in wall between A and X.

Assume a ventilated room, northern exposure, (see Table 13) (well-constructed subject to reasonable exposure).

NOTE: In solving the application problems for this section, the work should be presented in as full detail as the solution of the demonstration problem, directly following.

DEMONSTRATION PROBLEM—SOLUTION

Wall between A and Y.
Gross area of wall = 30 ft. × 10 ft. = 300 sq. ft.
Area windows 3 × (4 ft. × 5 ft.) = 60 sq. ft.
Net area of wall 300 — 60 = 240 sq. ft.
Temperature difference = 70° — 0° = 70° F.
Heat loss for wall=240 (sq. ft.) × 70 (temp. diff.) × 0.28 (factor) = 4704 B.T.U.
Exposure allowance for wall = 4704 × 0.25 = 1076 B.T.U.
Total loss for wall = 4704 + 1076 = 5780 B.T.U.
Heat loss for windows = 60 (sq. ft.) × 70 (temp. diff.) × 1.10 (factor) = 4620 B.T.U.
Exposure loss for windows = 4620 × 0.25 = 1155 B.T.U.

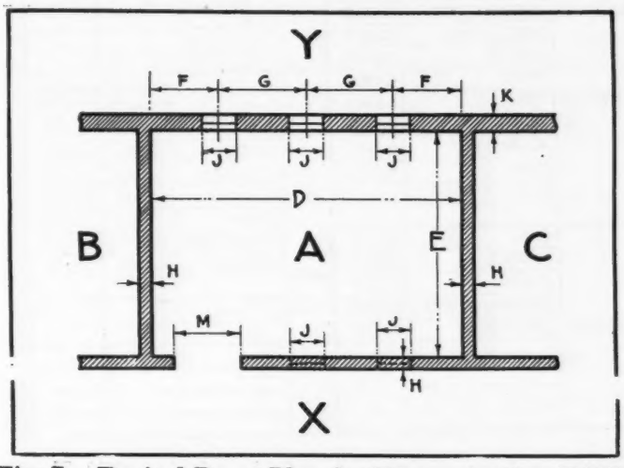

Fig. 7.—Typical Room Plan for Demonstrating B.T.U. Method of Heat-Loss Calculations

Total loss for windows = 4620 + 1155 = 5775 B.T.U.
Total loss from A to Y = 5780 + 5775 = 11,555 B.T.U.

Wall between A and B.
Gross area of wall = 22 ft. × 10 ft. = 220 sq. ft.
Area of openings = none.
Net area of wall = 220 sq. ft.
Temperature difference = 70° — 60° = 10° F.
Heat loss from A to B = 220 (sq. ft.) × 10 (temp. diff.) × 0.34 (factor) = 748 B.T.U.

Wall between A and C.
Gross area of wall = 22 ft. × 10 ft. = 220 sq. ft.
Area of openings = none.
Net area of wall = 220 sq. ft.
Temperature difference = 70° — 65° = 5° F.
Heat loss from A to C = 220 (sq. ft.) × 5 (temp. diff.) × 0.34 (factor) = 374 B.T.U.

Wall between A and X.
Gross area of wall = 30 ft. × 10 ft. = 300 sq. ft.
Area of door = 4 ft. × 7 ft. = 28 sq. ft.
Net area of wall = 300 — 28 = 272 sq. ft.
Temperature difference = 70° — 40° = 30° F.
Heat loss for wall = 272 (sq. ft.) × 30 (temp. diff.) × 0.34 (factor) = 2774 B.T.U.
Heat loss for door = 28 (sq. ft.) × 30 (temp. diff.) × 0.50 (factor) = 420 B.T.U.
Total loss from A to X = 2774 + 420 = 3194 B.T.U.

Floor.
Gross area of floor = 30 ft. × 22 ft. = 660 sq. ft.
Temperature difference = 70° — 50° = 20° F.
Heat loss thru ceiling = 660 (sq. ft.) × 20 (temp. diff.) × 0.11 (factor) = 1452 B.T.U.

Ceiling.
Gross area of ceiling = same as floor = 660 sq. ft.

TABLE 14. SPECIFIC HEAT VALUES FOR VARIOUS SUBSTANCES

	SUBSTANCE	SPECIFIC HEAT		SUBSTANCE	SPECIFIC HEAT
LIQUIDS	WATER	1.0000	BUILDING MATERIALS	BRICKWORK	0.1950
	ALCOHOL	0.6220		MASONRY	0.2000
	TURPENTINE	0.4720		PLASTER	0.2000
	OLIVE OIL	0.3090		PINE WOOD	0.4670
	PETROLEUM	0.4340		OAK WOOD	0.5700
				BIRCH	0.4800
				GLASS	0.1977
METALS	CAST IRON	0.1298			
	WROUGHT IRON	0.1138			
	SOFT STEEL	0.1165			
	COPPER	0.0951			
	BRASS	0.0939		CONSTANT PRESSURE	CONSTANT VOLUME
	TIN	0.0569			
	LEAD	0.0314	GASES	AIR	0.2415 / 0.1729
	ALUMINUM	0.2185		OXYGEN	0.2175 / 0.1550
	ZINC	0.0953		HYDROGEN	3.4090 / 2.4122
				NITROGEN	0.2438 / 0.1727
				STEAM	0.5000 / 0.3500
MINERALS	COAL	0.2777		CARBONIC ACID CO$_2$	0.2479 / 0.1758
	MARBLE	0.2159		AMMONIA	0.5080 / 0.2990
	CHALK	0.2149			
	STONES, GENERAL	0.2100			
	LIMESTONE	0.2170			

Temperature difference = 70° — 35° = 35° F.
Heat loss thru ceiling = 660 (sq. ft.) × 35 (temp. diff.) × 0.60 (factor) = 13,860 B.T.U.

All Losses—From A to Y = 11,555 B.T.U.
A to B = 748 B.T.U.
A to C = 374 B.T.U.
A to X = 3,194 B.T.U.
Floor = 1,452 B.T.U.
Ceiling = 13,860 B.T.U.

Total from Room = 31,183 B.T.U.

Work Problems Nos. 37, 38 and 39

SPECIFIC HEAT VALUES

Specific heat was defined and explained in Lesson 1. In Table 14 specific heat values for various substances are given. These values have been determined experimentally.

The quantity of heat added to or removed from a body is equal to the product of the weight of the body in pounds, multiplied by the specific heat of the material of which the body is composed and this product multiplied by the temperature range in degrees, through which the body has passed.

Thus the quantity of heat added to or removed from a body may be calculated as follows:

First: Determine the weight of the body in pounds.
Second: Select a specific heat value corresponding to the material.
Third: Determine the increase or decrease in the temperature of the body.
Fourth: Multiply First by Second by Third and obtain the heat units added to or taken from the body.

APPLICATION OF SPECIFIC HEAT VALUES

When steam or water is first admitted into the heating system, the temperature of radiators and piping must first be brought to the temperature of the heating medium. The quantity of heat required to raise the temperature of a 300 lbs. cast-iron radiator to that at which it is to operate may be determined by applying the four-step form above as follows:

First: Weight of body = 300 lbs.
Second: Specific heat of cast-iron = 0.1298 (by Table 14).
Third: Initial temperature of radiator = 50° F.
Temperature steam at 5.3 lbs./sq. in. pressure, (gage) = 228° F.
Increase in temperature = 228 — 50 = 178° F.
Fourth: Heat units required = 300 × 0.1298 × 178 = 6930 B.T.U.

Work Problems Nos. 40 and 41

HEAT REQUIREMENTS OF BUILDINGS INTERMITTENTLY HEATED

Buildings such as churches and large assembly halls which are heated intermittently require special consideration as to heating requirements. Before the temperature within can be maintained at that desired for the comfort of the occupants, a sufficient quantity of heat must be introduced to change the temperature of the integral parts of the structure itself. With a plant of sufficient capacity, the temperature within can be brought to the desired point in a reasonable length of time. If the plant is too small, fires, in very cold weather, must be started many hours before the building is to be used and it is not infrequent that the temperature in some structures is considerably lower than that desired at the hour when the occupants arrive.

TABLE 15
PROPERTIES OF AIR

TEMP °F.	VOLUME OF DRY AIR WITH UNITY AT 32°F.	SPECIFIC VOLUME CU. FT. IN 1 LB. OF AIR	SPECIFIC DENSITY WEIGHT OF 1 CU. FT. OF DRY AIR	ELASTIC FORCE OF VAPOR INS. OF MERCURY	FEET OF VAPOR FROM 1 LB OF WATER	B.T.U. ABSORBED BY 1 CU. FT. OF AIR PER DEGREE F.		CU. FT. OF AIR RAISED 1°F. BY 1 B.T.U.	
						DRY AIR	SAT AIR	DRY AIR	SAT. AIR
1	2	3	4	5	6	7	8	9	10
0	0.935	11.58	0.0864	0.044	—	0.02056	0.02054	48.5	48.7
12	0.960	11.87	0.0842	0.074	—	0.02004	0.02006	50.1	50.0
22	0.980	12.14	0.0824	0.118	—	0.01961	0.01963	51.1	51.0
32	1.000	12.40	0.0807	0.181	32.89	0.01921	0.01924	52.0	51.8
42	1.020	12.64	0.0791	0.267	22.52	0.01882	0.01884	53.2	52.8
52	1.041	12.88	0.0776	0.388	15.95	0.01847	0.01848	54.0	53.8
60	1.057	13.09	0.0764	0.522	12.27	0.01818	0.01822	55.0	54.6
62	1.061	13.13	0.0761	0.556	11.35	0.01811	0.01812	55.2	54.7
70	1.078	13.34	0.0750	0.754	8.82	0.01777	0.01794	56.3	55.5
72	1.082	13.39	0.0747	0.785	8.19	0.01767	0.01790	56.5	55.8
82	1.102	13.64	0.0733	1.092	6.00	0.01744	0.01770	57.2	56.5
92	1.122	13.90	0.0720	1.501	4.44	0.01710	0.01751	58.5	57.1
100	1.139	13.95	0.0710	1.929	3.56	0.01690	0.01735	59.1	57.8
102	1.143	14.14	0.0707	2.036	3.34	0.01682	0.01731	59.5	57.8
112	1.163	14.40	0.0694	2.731	2.53	0.01651	0.01711	60.6	58.5
122	1.184	14.65	0.0682	3.621	1.94	0.01623	0.01691	61.7	59.1
132	1.204	14.90	0.0671	4.752	1.51	0.01596	0.01670	62.5	59.9
142	1.224	15.15	0.0660	6.165	1.18	0.01571	0.01652	63.7	60.6
152	1.245	15.40	0.0649	7.930	0.93	0.01544	0.01634	64.8	61.5
162	1.265	15.65	0.0638	10.099	0.745	0.01518	0.01616	66.2	62.4
172	1.285	15.90	0.0628	12.758	0.592	0.01494	0.01598	67.1	63.3
182	1.306	16.17	0.0618	15.960	0.486	0.01471	0.01580	68.0	64.2
192	1.326	16.42	0.0609	19.828	0.398	0.01449	—	68.9	—
202	1.347	16.67	0.0600	24.450	0.327	0.01426	—	69.5	—
212	1.367	16.92	0.0591	29.921	0.271	0.01406	—	71.4	—

It is important, therefore, that consideration be given this feature of heating requirements especially for such buildings when the interval between use is long enough to permit all parts of the building to have become entirely cooled.

Problems of this kind should be solved by calculating the total weight of the different materials of which the structure is composed such as stone work, woodwork, slate, plaster, air, etc. and then determining the number of heat units required to raise the temperature of all substances, as explained above in the case of a radiator. After computing the total heat required, a percentage is added to care for furnishings.

Fig. 8 shows the general shape and dimensions of a church for which it is desired to know the quantity of heat required to raise the temperature of the structure and contents when it has been unheated for a period of such length that all parts have become cooled to the outside temperature.

Work Problem No. 42

Having determined the number of heat units required to raise the temperature of a structure and its contents to that at which it is to be maintained, it is only necessary to know the capacity of the heating plant in order to estimate the time at which heating must be started so that the room will be comfortable when the first occupants arrive.

If it is assumed that 120,000,000 B.T.U. are required to raise the temperature of a given structure to its desired temperature and the plant is capable of supplying heat at the rate of 30,000,000 B.T.U. per hour, 4 hours would be required, providing there was no transmission of heat to the outside. Since this will always occur whenever the temperature within differs from that without, a percentage may be added to estimate for this loss. If the total heat units required be increased 50% and this figure divided by the capacity of the plant the result will be a fair average of the time required. If the outside temperature is very low and a high wind is blowing more time will be needed.

Work Problem No. 43

INFILTRATION OR LEAKAGE

To make computations for heat losses by the B.T.U. method as nearly correct as possible, a quantity which has not been considered so far in the course, known as INFILTRATION OR LEAKAGE should be included. By INFILTRATION is meant the quantity of outside air which may enter by "filtering in" or leaking into a room through the cracks or clearances around windows and doors or through the walls themselves, especially when the building is of poor workmanship.

The heat necessary to take care of this infiltration is that required to warm the outside air which filters in and to raise its temperature from that outside to the inside temperature.

As when calculating transmission losses, the time unit is taken as one hour. The quantity of air is usually expressed as its weight in pounds.

This quantity of air that enters through building construction cracks, openings around windows and doors, etc., is often of considerable moment and introduces a factor which, if not provided for in heating plant capacity, will result in poor and unsatisfactory service, especially in severe weather. Each installation presents a particular problem and should have due consideration.

The volume of air entering a building as in-leakage is not susceptible to very precise calculation. It depends upon the width of crack opening, total lineal feet of opening and wind velocity. Infiltration losses can be materially reduced by the use of storm doors and windows, metal weather-stripping on doors and windows, by calking around doors and

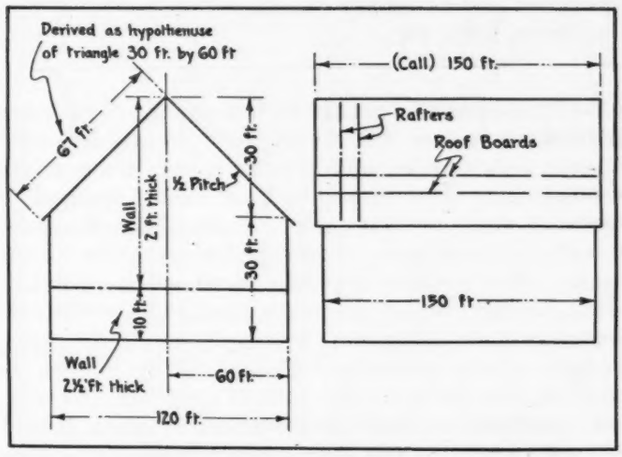

Fig. 8.—General Dimensional Notes for a Church for Demonstrating Heating Requirements of Buildings Intermittently Heated

casing in frame construction; by close-fitting tongue-and-groove strips covered with heavy building paper, and by using insulating material in the wall construction.

Specific density or weight of air was explained in Lesson 1 and it was shown there that as a unit volume of air becomes warmer, its weight becomes less. All in-leaking air must be heated from the outside air temperature to that of the heated room. By Table 15, Properties of Air, it is noted by column 4 that 1 cu. ft. of air at zero degrees weighs 0.0864 lbs. while at 70° F., the same volume weighs only 0.0750 lbs. Therefore, by dividing 0.0750 by 0.0864, it is found that 0.87 cu. ft. of air at 0° F. becomes 1 cu. ft. when heated to 70° F.

Work Problem No. 44

The specific heat of air as commonly used is 0.24. Therefore, to raise 0.87 cu. ft. of air from 0° F. to 70° F., the heat units required will be.

0.075 (lbs.) × 0.24 (sp. ht.) × 70 (deg.) = 1.260 B.T.U.

Work Problem No. 45

Two methods for figuring infiltration losses are at present used by heating engineers. The more common method is to estimate the infiltration of air into a building in terms of the number of air changes or number of times per hour the air which

TABLE 16. AIR CHANGES PER HOUR

Space	Air changes per hour.
Halls, first floor	2 to 3
Halls, second floor	1
Halls, living room	2 to 3
Living rooms	1 to 2
Living rooms with fireplace, without damper	2 to 4
Dining rooms	1 to 2
Sleeping rooms	1
Bath and serving room	2
Kitchen and offices	1 to 2
Drug stores	2 to 3
Clothing stores	1
Churches and assembly rooms	1 to 2
Factories, lofts, etc.	1 to 2

leaks in displaces the air in the room. The other method is to use the lineal feet of window and outside door cracks, and assume a maximum width of opening. The lineal feet of crack method is probably more accurate, since it considers the relation of the glass area to the cubical contents of the room. This method involves more work in calculation, though, which probably accounts for the air-change method being more generally used. In cases, though, where combined glass and door area is small in proportion to the cubical contents, the heat loss calculated on basis of lineal feet of crack should be checked against the air-change method to be sure that it is not less than the equivalent for one air change per hour.

INFILTRATION BY THE AIR-CHANGE METHOD .

In Table 16, values are given for the number of air changes per hour commonly used in several types of buildings and rooms.

If we assume the room of Fig. 5 to represent a living room, and allow two air changes per hour, the volume of the room being 10 ft. × 14 ft. × 9 ft. = 1260 cu. ft., the total air entering per hour will be twice this quantity, or 2520 cu. ft. It requires approximately 0.02 B.T.U. to raise the temperature of 1 cu. ft. of air at 0° F. to 1° F. Therefore, since this 2520 cu. ft. must have its temperature raised from 0° F. to 70° F, the total heat units required to care for infiltration on this basis will be 2520 (cu. ft.) × 70 (temp. diff.) × 0.02 (B.T.U.) = 3528 B.T.U. per hour.

TABLE 17

B.T.U. REQUIRED PER CUBIC FOOT FOR VARIOUS AIR CHANGES AND TEMPERATURE CHANGES

TEMP. RISE °F.	NUMBER AIR CHANGES PER HOUR								
	½	1	1½	2	3	4	5	6	10
1	2	3	4	5	6	7	8	9	10
5	0.05	0.09	0.14	0.18	0.27	0.36	0.45	0.55	0.91
10	0.09	0.18	0.27	0.36	0.55	0.73	0.91	1.09	1.82
15	0.14	0.27	0.41	0.55	0.82	1.09	1.36	1.64	2.73
20	0.18	0.36	0.55	0.73	1.09	1.45	1.82	2.18	3.64
25	0.23	0.45	0.68	0.91	1.36	1.82	2.27	2.73	4.55
30	0.27	0.55	0.82	1.09	1.64	2.18	2.73	3.27	5.45
35	0.32	0.64	0.95	1.27	1.91	2.55	3.18	3.82	6.36
40	0.36	0.73	1.09	1.45	2.18	2.91	3.64	4.36	7.27
45	0.41	0.82	1.23	1.64	2.45	3.27	4.09	4.91	8.18
50	0.45	0.91	1.36	1.82	2.72	3.64	4.55	5.45	9.09
55	0.50	1.00	1.50	2.00	3.00	4.00	5.00	6.00	10.00
60	0.55	1.09	1.64	2.18	3.27	4.36	5.45	6.55	10.91
65	0.59	1.18	1.77	2.36	3.54	4.72	5.91	7.09	11.82
70	0.64	1.27	1.91	2.54	3.82	5.09	6.36	7.64	12.72
75	0.68	1.36	2.05	2.73	4.09	5.45	6.82	8.18	13.63
80	0.73	1.45	2.18	2.91	4.36	5.82	7.27	8.72	14.54
85	0.77	1.55	2.32	3.09	4.64	6.17	7.73	9.27	15.45
90	0.82	1.64	2.46	3.27	4.91	6.55	8.18	9.83	16.36

Work Problem No. 46

The use of Table 17 will be found convenient in calculating infiltration requirements by the air-change method. This table shows the number of heat units required per cubic foot for different air changes and temperature rises.

If infiltration demands are to be calculated on the basis of one air change for a room 15 ft. × 15 ft. × 10 ft. maintained at 70° F. when the outside temperature is 0° F., procedure is as follows:

Temperature rise = 70° — 0° = 70° F.
Cubical contents = 15 × 15 × 10 = 2250 cu. ft.
Factor from table = 1.27.
B.T.U. for leakage = 2250 × 1.27 = 2857 B.T.U.

(*Continued on Page 67*)

TABLE 18

WINDOW LEAKAGE DATA

	LEAKAGE, C.F.M. CRACK PERIMETER 18 FT. 4 INS.				B.T.U. PER HOUR 0-70 DEG. F.				B.T.U. PER HOUR 20-70 DEG. F.			
	FOR TOTAL WINDOW		PER FT. CRACK		FOR TOTAL WINDOW		PER FT. CRACK		FOR TOTAL WINDOW		PER FT. CRACK	
WIND VELOCITY M.P.H.	14.4	24.9	14.4	24.9	14.4	24.9	14.4	24.9	14.4	24.9	14.4	24.9
PLAIN WINDOW												
VERY TIGHT-UNLOCKED	19.0	40.0	1.04	2.18	1445	3040	78.7	166.0	1033	2170	56.3	118.5
TIGHT-UNLOCKED	22.0	46.0	1.20	2.53	1673	3500	91.3	192.5	1195	2500	65.2	137.5
⅛" TO ¼" CRACK-UNLOCKED	46.0	75.0	2.53	4.08	3500	5700	192.5	310.0	2500	4075	137.5	222.0
RIB WEATHER STRIP												
1/16" CRACK	9.0	20.0	0.49	1.09	685	1522	37.3	83.0	488	1087	26.6	59.2
⅛" CRACK	11.0	22.5	0.60	1.25	837	1710	45.6	95.1	598	1223	32.6	67.9
3/16" CRACK	15.0	30.0	0.82	1.63	1141	2282	62.2	124.6	815	1630	44.4	88.8
¼" CRACK	18.0	36.0	0.98	1.96	1370	2740	74.7	149.4	978	1956	53.3	106.6
INTERLOCKING WEATHER STRIP												
1/16" CRACK	7.0	16.0	0.38	0.87	533	1218	29.0	66.3	380	870	20.7	47.3
⅛" CRACK	8.5	18.0	0.46	0.98	647	1370	35.3	74.7	462	978	25.2	53.3
3/16" CRACK	9.0	19.5	0.49	1.06	685	1483	37.3	80.9	489	1060	26.6	57.8
¼" CRACK	10.0	20.5	0.55	1.12	761	1560	41.4	85.0	543	1114	29.6	60.7

H. & V. E. G. 1924-25

TABLE 19

WINDOW LEAKAGE DATA

DOUBLE HUNG WINDOW

LEAKAGE —CU. FT. PER HOUR PER FOOT OF CRACK PER MILE OF WIND VELOCITY
B.T.U. PER HOUR PER FOOT OF CRACK PER MILE OF WIND VELOCITY PER 70°F. TEMP. DIFF.

CLEARANCE	CRACK INS.	PLAIN 1/16"-¼"		INTERLOCKING TYPE WEATHER STRIPPING. 1/16"		⅛"		3/16"		¼"	
		L.KG.	B.T.U.	L.KG.	B.T.U.	L.KG.	B.T.U.	L.KG.	B.T.U.	L.KG.	B.T.U.
	1/32	4.3	5.45	1.32	1.67	1.48	1.87	1.63	2.07	1.79	2.27
	1/16	6.6	8.36	1.56	1.98	1.72	2.18	1.88	2.39	2.05	2.59
	3/32	8.9	11.90	1.67	2.11	1.83	2.32	2.00	2.54	2.17	2.75
	⅛	11.2	14.2	1.71	2.17	1.89	2.39	2.06	2.62	2.24	2.84
	3/16	15.7	19.9	1.74	2.20	1.94	2.45	2.13	2.70	2.33	2.95
	¼	20.2	25.6	1.75	2.22	1.96	2.48	2.17	2.75	2.38	3.02
	CRACK INS.	RIB TYPE WEATHER STRIPPING 1/16"		⅛"		3/16"		¼"	
		L.KG.	B.T.U.	L.KG.	B.T.U.	L.KG.	B.T.U.	L.KG.	B.T.U.
	1/32	2.31	2.93	2.51	3.18	2.80	3.55	3.34	4.23
	1/16	2.52	3.19	2.71	3.43	3.04	3.85	3.56	4.51
	3/32	2.63	3.33	2.83	3.58	3.17	4.02	3.71	4.70
	⅛	2.68	3.39	2.89	3.66	3.26	4.12	3.83	4.85
	3/16	2.72	3.44	2.95	3.74	3.35	4.24	3.98	5.04
	¼	2.73	3.46	2.99	3.78	3.41	4.32	4.10	5.19

H. & V. E. G. 1924-25

Back To First Principles

Plain Answers to Direct Questions on Present-Day Heating and Ventilating Practice

By T. W. Reynolds

(Continued from the December issue)

Circulating Water Below Its Heating Source Without Mechanical Means

THE installation in the Irvington Pastime Club, described in the November, 1924, issue, brings to mind a somewhat similar case in a store at Yonkers, N. Y., though more difficult because the water radiators are 4 ft. below the bottom of the steam boiler, and more interesting because the heating system is a combination steam and water installation (See Fig. 41).

For various reasons the rooms occupied as stores were formerly heated by stoves and a cast-iron sectional steam boiler was set in the rear of the building at the higher level shown in order to supply heat to the steam radiators on upper floors. These radiators are not shown in the sketch.

Later it became desirable that some method of heating other than stoves be used in the stores. Steam was out of the question as there was no practical way in which the condensation could be returned by gravity so radiators of the hot water pattern were installed in the stores and the water warmed by Excelso water heaters, the boiler having sufficient capacity for both steam and water heating systems.

At first there were two such heaters, each connected in the usual manner to the steam boiler with coil immersed below the boiler water-line so as to transfer heat from the water in the steam boiler to the water in the secondary heating system.

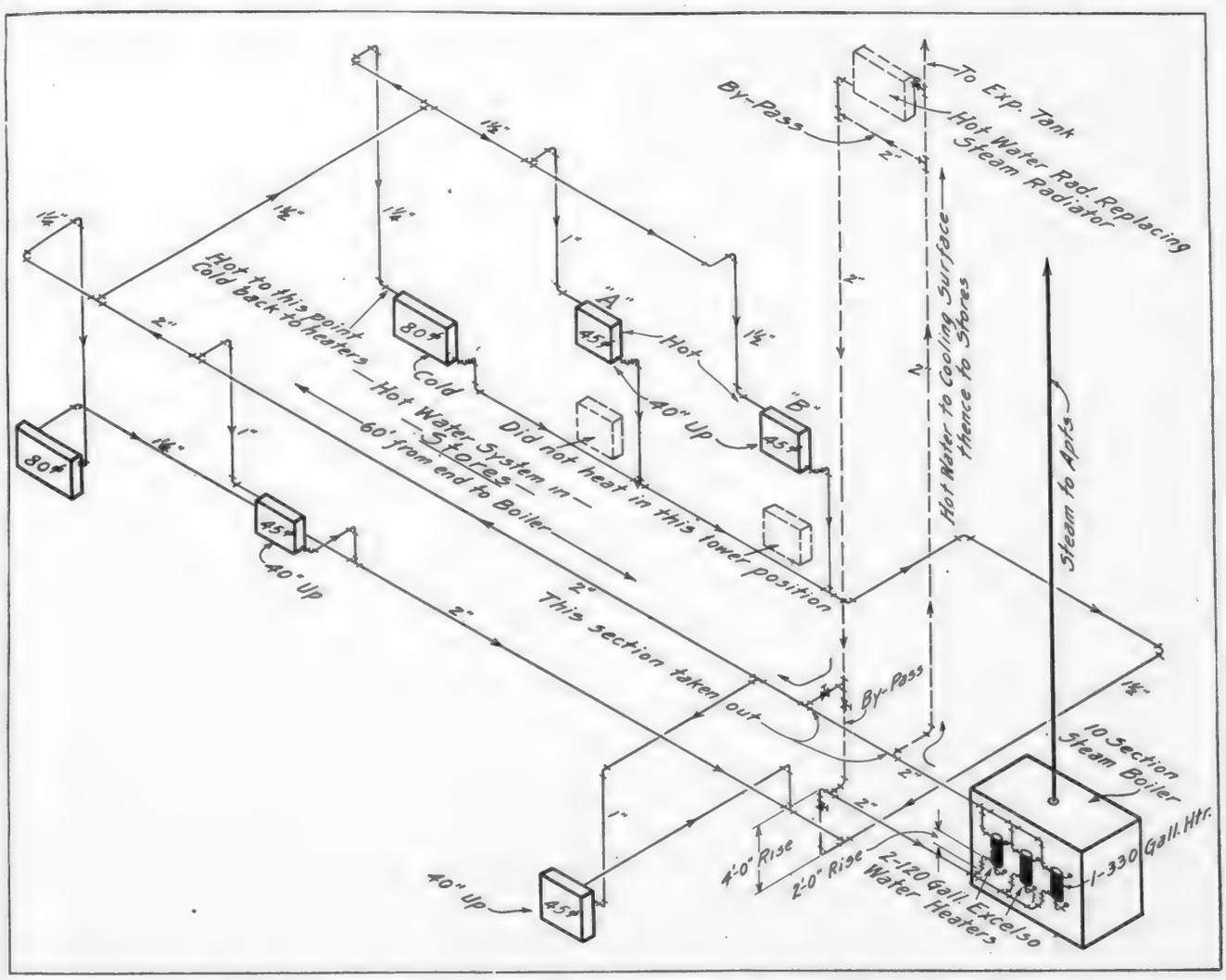

Fig. 41.—Arrangement for Circulating Water to Radiators Well Below Heater Level With a Combination Steam and Water Heating System

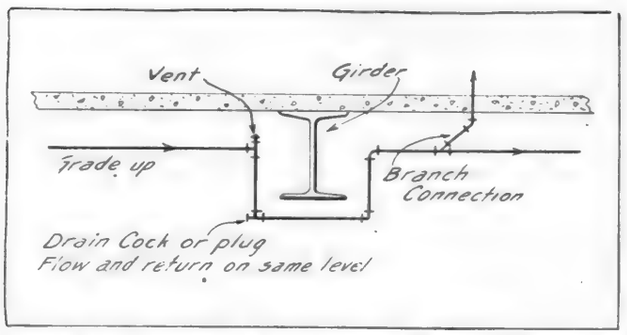

Fig. 42.—Method of Circulating Water Through a Pocket in the Main

Then as it was found that the water heating system was hot and cold in spots, a third heater was installed in order to furnish additional heating capacity, but conditions remained about as before.

As will be readily seen, this method of cut-and-try was rather expensive, yet still another error was made by lowering radiators "A" and "B" to the positions shown dotted. Quite naturally this did not help matters, but instead made them worse, as these two radiators, formerly hot now failed to heat at all.

As a final experiment (and what should have been done in the start) the supply from the Excelso heaters was connected to a water radiator substituted for one of the steam radiators on the uppermost floor, the arrangement being made as shown in dotted. Then a connection was made just below this radiator to its supply line and from this point a drop line carried down to supply all water radiators in the stores. After this work was completed, no further troubles were experienced, both steam and water heating systems operating satisfactorily.

SOME WATER HEATING PROBLEMS USUALLY AVOIDED, BUT WHICH MAY BE SOLVED BY PROPER DESIGN

As heating engineers we are often misled through our desire to avoid all traps, pockets, or other depressions liable to accumulate air, but with proper relation of elevation to depression and suitable provision for the relief of air there should be no trouble, as previously stated, for example, Fig. 42 shows how both flow and return mains may be dropped so as to pass under a girder and then raised to the same grade on the other side, yet without affecting the circulation. With such connections, plugged tees should be provided at the low point for draining. An air vent should also be installed at the high point of the flow just before its depression.

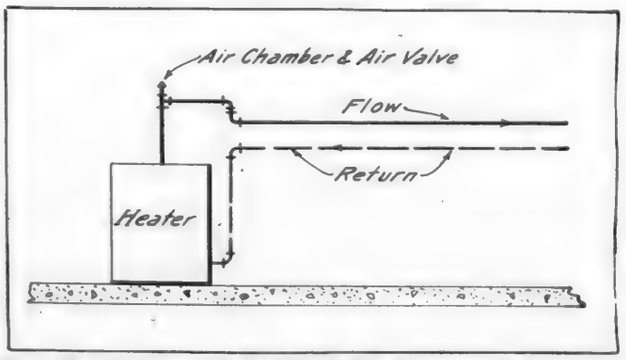

Fig. 43.—How a Main May Be Depressed to Avoid Pitting the Boiler Without Affecting Circulation

Again, wherever a heater is placed with one of greater height, the depression made by the lower elevation of the existing main will not matter, providing relief for the air is made as shown in Fig. 43. This method obviates pitting of the boiler as would otherwise be required. Then, we are all familiar with the "D" connection shown in Fig. 44. This connection, though sometimes made in order to pass under a pipe or other obstruction, is more commonly used for branches connecting from the main nearest the heater to second or higher-floor radiators, the object being, of course, to take the water from where it is coolest, and thus prevent the first radiators from getting the best of the ciculation. When such a connection is used a ⅛-in. pet cock should be tapped into the 45° ell for drainage purposes.

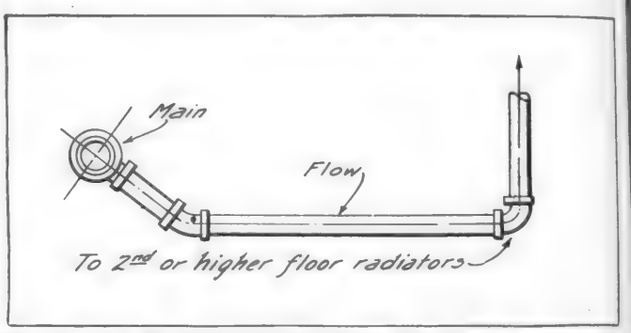

Fig. 44.—A Commonly-Used Depression for Branches From the Main Which Does Not Hinder Circulation

SOME OF THE MORE USUAL PROBLEMS ENCOUNTERED IN CIRCULATING WATER BELOW ITS HEATING SOURCE SUMMARIZED BY SKETCHES

Nearly all of these problems may be solved according to the principle outlined at the beginning, hence the several ways of overcoming such difficulties may be easily summarized by sketch as shown in Fig. 45.

Fig. 45 is shown first merely to illustrate how the circulation may be increased in radiators and at the same time make quite a saving in pipe, the several radiators being connected through one loop as shown. Referring, next, to Fig. 46, the first basement radiator from the heater is fed by a drop taken from the flow riser which extends to the second and third-floor radiators. The second basement radiator is also supplied by a drop riser, but the motive power or circulation within this riser will be somewhat less, for it is farther from the heater and extends to the second floor only. For this reason, it is connected to the return (instead of the flow) from the radiator on the second floor. By means of this full advantage is taken of the greater temperature difference between the flow and return, hence the circulation is increased. As for the third or last basement radiator, there is no other alternative than to provide a simple loop to the ceiling of the first floor and rely upon the down

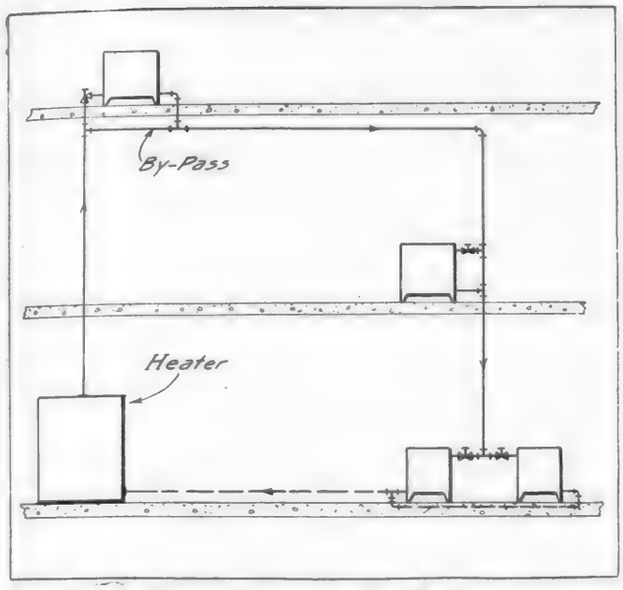

Fig. 45.—Radiators Connected in Series to Increase Circulation in Basement Radiators

portion of the loop to maintain circulation due to its cooling effect. This loop should be vented (see sketch) as there is no second-floor radiator available for this purpose.

It will be seen, of course, that the closing of the valve on the second basement radiator will stop the circulation through the upper radiator. It should also be noted that the returns from upper-floor radiators near the heater are carried back separately for if connected directly into the main return such radiators, due to their more rapid circulation would tend to slow up the circulation to the more distant radiators.

Where basement radiators are in a one-story building conditions are much more difficult, but even then circulation may usually be established if the connections are made as shown in Fig. 47. In this sketch, the nearest basement radiator to the heater is connected at the bottom with a 45° elbow turned down. This takes the colder water from the bottom of the flow main as is desirable because of its proximity to the heater and also eliminates an air pocket as would be caused by a connection from the top.

Next, the second basement radiator is favored because of its connection which is made not only at a higher point, but also so as to connect with the return of the first-floor radiator, both of which are advantages due to the increase in differential weight of water in the flow and return. Furthermore, the expense of a loop to the uppermost floor is avoided.

The third or last basement radiator, being farther from the boiler, takes its supply from the hotter water which is in the flow branch connected to the radiator immediately above on the first floor. This is done in order to obtain the increased circulation due to the greater temperature drop which is then possible in the basement radiator.

In Figs. 46-47 all air in the system is vented through the high points which are through the air valves on the upper-floor radiators, consequently no air valves are required on the basement radiators. But if we meet with a problem as shown in Fig. 48 the air must be vented by other means. In such a case the water from the heater should be run up first to the expansion tank before supplying the radiators. This tank, of course, is provided for the expansion of water, but due to its location all air in the system will tend to vent at this high point rather than drop to the lower level of the flow main.

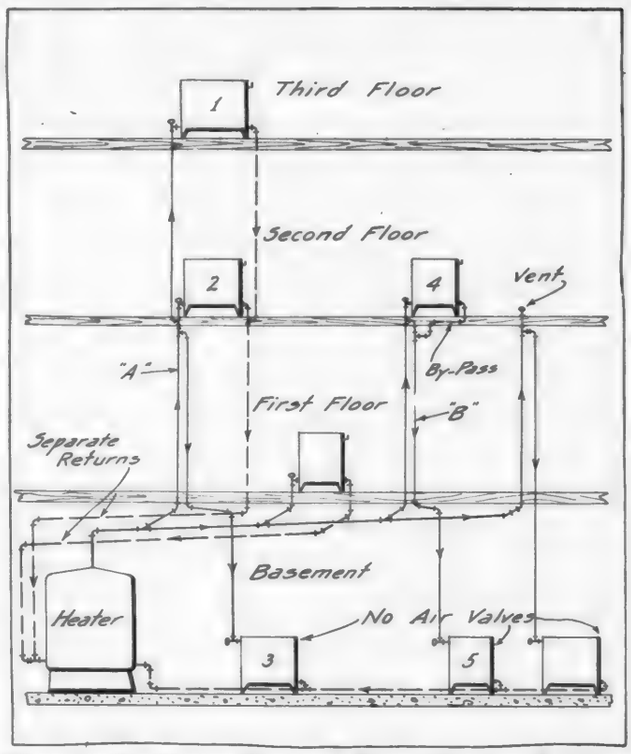

Fig. 46.—Solution of Various Water Heating Problems

Now assume a condition, as sometimes happen, where it is undesirable to run the return along the floor. In such a case circulation can still be maintained by arranging the piping as shown in Fig. 49 with a separate return from an upper-floor radiator run, first, as a supply to a basement radiator, then as a return from this radiator up and back to the heater by means of an overhead main, by-passing the basement radiator as shown, if so desired.

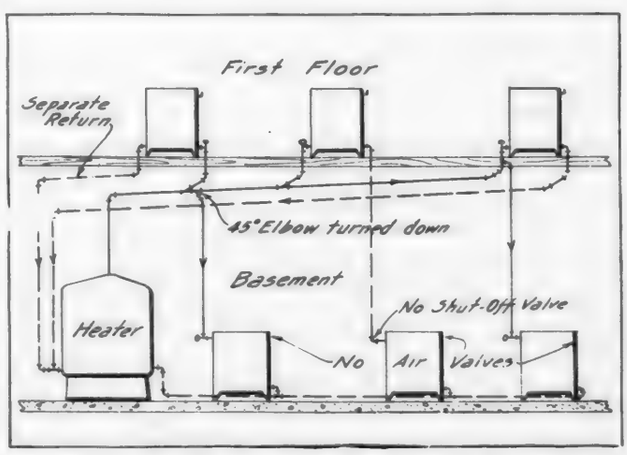

Fig. 47.—How Water May Be Circulated to Basement Radiators in a One-Story Building

A Short, Practical Method of Designing Gravity Water Heating Systems

With Six Illustrative Problems Frequently Encountered in Practice, and Their Solutions

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VII—The Design of a One-Pipe System with Overhead Distribution and Reversed Return

Previous articles in this series are as follows: January, 1924, Design of an Elementary Heating System; February, 1924, Design of a Simple Water Heating System; April, 1924, Design of One-Piece System for a Small Building; June, 1924, Design of a Simple Two-Pipe System; August, 1924, Design of Two-Pipe Systems with Direct or Reversed Returns; October, 1924, The Design of a Two-Pipe System with Overhead Distribution and Reversed Return.

LET it be required to design the pipe lines and radiators for the system shown in Fig. 15. The system is intended for a four-story building, with basement, requiring 250,000 B.T.U. per hour. The quantities of heat dissipated by the several radiators, and those conveyed by the several sections of flow and return mains and by the several risers, are shown in the figure and in the corresponding tables.

The system is to have over-head distribution, reversed return, and one-pipe return risers.

The terms "one-pipe system" and "one-pipe return riser" are used to indicate that water leaving the heater will flow through more than one radiator before returning to the heater and that, consequently, the temperature at which water enters the several radiators is not the same in all cases.

The centers of the four groups of radiators are to be, respectively, 7 ft., 17 ft., 27 ft., and 37 ft. above the center of the heater. The center of the basement radiator is to be 7 ft. below the center of the heater. The water is to leave the heater at a temperature of 200° F. The average temperature of the air in the building is to be 70° F.

To simplify the drawing, only three of the six return risers are shown, and the larger number of the necessary elbows and short pipe lines are omitted.

The three return risers, shown in the drawing, are connected to their respective radiators in various ways in order to illustrate the method of designing the several types of radiator connections occurring in practice.

The essential features of a system having one-pipe return risers, like that shown in Fig. 15, which differ materially from those of a system having two-pipe return risers, like that shown in Fig. 14, are:

1. Every return riser, with the attached radiators, acts as a single radiator, and the pressure-head, which produces and maintains circulation through any one return riser, is caused by the difference in the pressure exerted by the water in that return riser and that exerted by the water in the corresponding flow riser:

2. The circulation through any radiator is independent of the location of that radiator with reference to the heater, so long as circulation exists in the return riser, since every radiator forms a small and independent system with the section of the return riser to which it is attached. This will be explained in detail in the design of the radiators and of the radiator connections to the return risers.

RETURN RISER THE UNIT, INSTEAD OF RADIATOR

In designing the pipe lines for a one-pipe system, we must design with the return riser as the unit, instead of with the radiator as the unit, and we must begin the design with that of the circuit of the least-favored return riser.

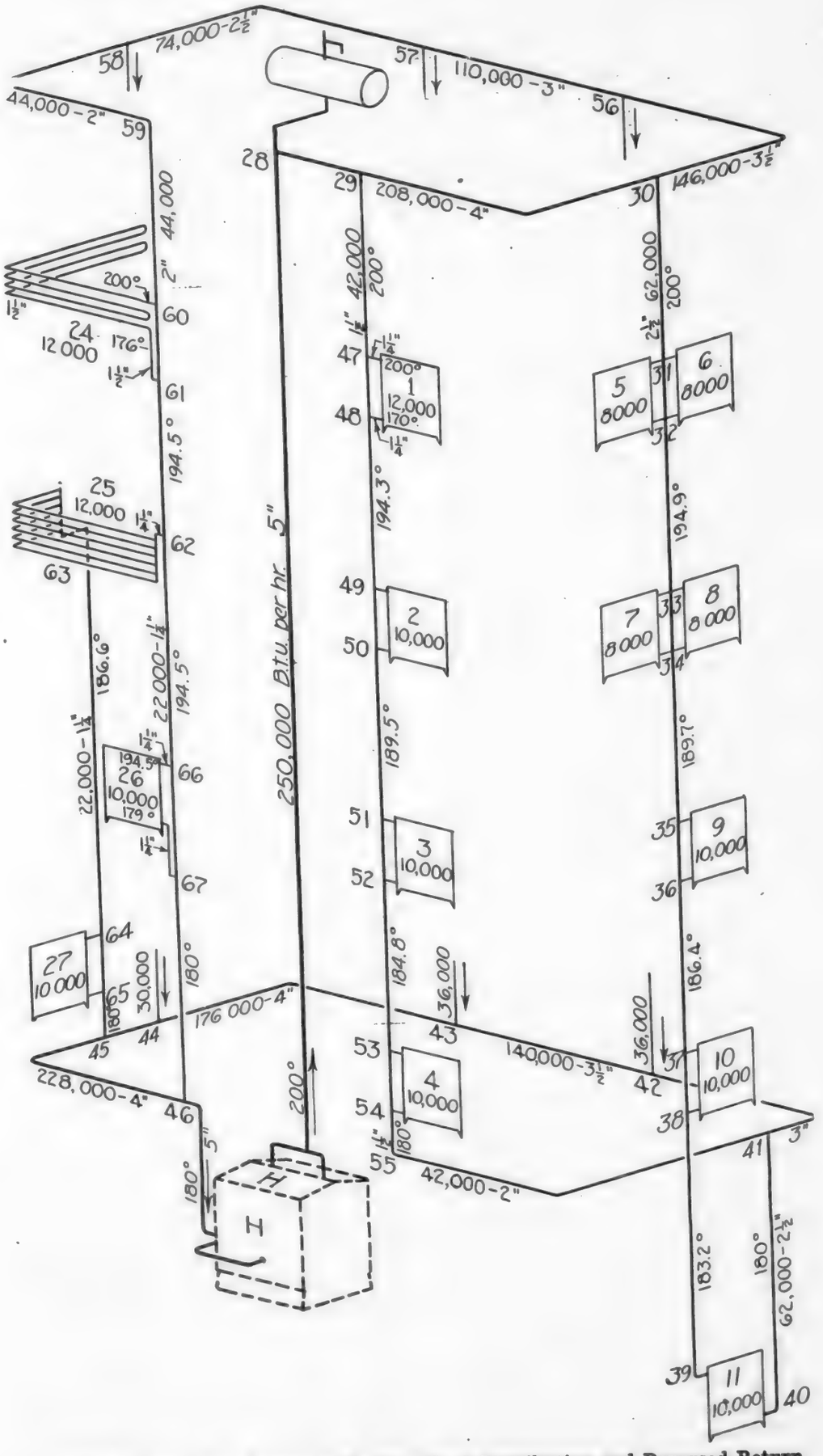
Since the system under consideration has a reversed return, the circuits of the six return risers would be, practically, of equal length if it were not for the basement radiator which is in the circuit of the second return riser and which makes that circuit materially longer than any one of the other five.

The pressure-head maintaining circulation through the second return riser is, probably, smaller than that maintaining circulation through the other five return risers, because the pressure difference caused by the weights of the water in those parts of the circuit which are located below the center of the heater tends to produce circulation in a direction opposite to that which exists in the circuit; its effect is, therefore, negative and deducts from the pressure-head which would exist for that circuit if the basement radiator were not present.

BEGINNING THE DESIGN WITH SECOND RETURN RISER

Since the circuit of the second return riser has, evidently, a greater length and a smaller pressure-head than any of the other five circuits, it is the least favored of the six and we will begin with the design of that circuit. To find the pressure-head, we must first determine the temperature difference with which the system is to operate. Within reasonable limits, we may assume this temperature difference at any desired value and calculate the corresponding pipe and radiator sizes. The larger we make the temperature difference, the larger will be the average radiator size and the smaller will be the average pipe size.

Let us determine whether a 20° temperature difference will require unreasonably large pipes. The second return riser is to deliver 62,000 B.T.U., per



Design of One-Pipe System with Over-Head Distribution and Reversed Return

hour to the building; it supplies heat to seven radiators, located at five separate elevations. The average temperature of the water in the return riser changes abruptly at each of these five elevations in proportion to the quantity of heat dissipated by each of the five groups of radiators. The successive changes in temperature may be calculated as follows:

If a 20° drop in temperature will release 62,000 B.T.U. to the building, it will require 16/62 of 20°, or 5.1°, to release the 16,000 B.T.U. which the two radiators on the fourth floor are to deliver to that floor. If the average temperature of the water entering the fourth floor radiator is 200°, the average temperature of the water entering the third floor radiator will be 200 — 5.1, or 194.9°. Similarly, the average temperature of the water in the lower sections of the return riser will be found to be, successively, 189.7°, 186.4°, 183.2°, and 180°, as shown on the riser diagram of Fig. 15.

The weight of the water in the return riser exerts a pressure on the water in the basement radiator and tends to cause flow through that radiator in the direction from Point 39 to Point 40. The weight of the water in the flow riser, from the basement radiator to the heater and from the heater to the fourth floor, exerts a similar pressure, but in the opposite direction. The difference between these two pressures maintains circulation through the basement radiator and, consequently, through the entire circuit; this difference in pressure determines the required pressure-head and can be found, approximately, from Diagram I, or, quite accurately, from Table 1, as shown in the following calculation.

The pressure, in pounds per square foot, caused by the water in the four sections of the return riser in which the temperature of the water differs from the temperature of the water in the corresponding sections of the flow riser, is:

10 ft. @ 194.9°	= 602.4	
10 ft. @ 189.7°	= 603.6	
10 ft. @ 186.4°	= 604.4	
11.4 ft. @ 183.2°	= 689.8	2500.2

The corresponding pressure, caused by the water in the flow riser, is:

7 ft. @ 180°	= 424.1	
34.4 ft. @ 200°	= 2068.1	2492.2

The difference between these two pressures is 8 lbs. per square foot. It is equal to the pressure caused by a column of 190° water having a height of $8 \times 12 \div 60.36$, or 1.59 in. The pressure-head for this circuit is, therefore, 1590 m. i. when the total temperature difference is 20°.

In this calculation we neglected the weight of the water in those portions of the flow and return risers which are located above the outlet connection of the fourth-floor radiators because the temperature of the water in both risers is assumed to be 200° and the weight of the water in those sections would not affect the pressure-head. Similarly, we neglected the weight of the water in those sections of the flow and return risers which connect the basement radiator to the heater and are located above the center of the heater and below the return main, because the temperature of the water in those sections of both risers is assumed to be 180°. The pressure-head calculation for the circuit was made as if the water were conveyed from the basement radiator to the heater by a single vertical pipe.

Having found the pressure-head, we prepare the table for Circuit 2 in the manner described for the system shown in Fig. 14.

TABLE FOR CIRCUIT 2
Available Pressure-Head = 1590 m. i.

Section	1,000 B.T.U.	Assumed Feet Elbows	Assumed Diameter In.	Assumed Unit Friction	Assumed Total Friction	Selected Diameter In.	Selected Unit Friction	Selected Total Friction
		50		6.4	320		2.2	111
H–28	250	4	4	49	196	5	19	76
		5		6.4	32		2.2	11
28–29	250	2	4	49	98	5	19	38
		18		4.6	83			
29–30	208	1	4	35	35	4		118
		13		5.4	70			
30–32	62	3	2½	23	69	2½		139
		10		5.4	54			
32–34	62	0	2½	23		2½		54
		10		5.4	54			
34–36	62	0	2½	23		2½		54
		10		5.4	54			
36–38	62	0	2½	23		2½		54
		11		5.4	59			
38–39	62	1	2½	23	23	2½		82
		4		5.4	22			
39–40	62	7	2½	23	161	2½		183
		15		5.4	81			
40–41	62	4	2½	23	92	2½		173
		13		5.0	65			
41–42	104	1	3	28	28	3		93
		12		4.2	50			
42–43	140	0	3½	26		3½		50
		18		3.5	63			
43–44	176	1	4	24	24	4		87
		3		4.6	14			
44–45	206	0	4	34		4		14
		15		5.5	83			
45–46	228	1	4	42	42	4		125
		12		6.4	77		2.2	26
46–H	250	6	4	49	294	5	19	114
Total					2243			1602

It is clear from this table that the flow riser must be a 5-in. pipe and the main portion of the return riser, a 2½-in. pipe. These sizes seem too large for a system as small as that under consideration and, for an actual installation, we would probably revise the design, selecting a total temperature difference of possibly 30°. Since the present calculation is made only for the purpose of explaining the method of designing, we will proceed and determine the sizes of the remaining return risers and of the corresponding portions of the mains.

DESIGN OF CIRCUIT 1

Having completed the design of Circuit 2, we may proceed to the design of any one of the remaining circuits. Let us take Circuit 1 next. For this circuit, the five successive average tempera-

tures of the water in the return riser are found, as explained above, to be 200°, 194.3°, 189.5°, 184.8°, and 180°, as recorded on the pipe diagram of Fig. 15.

The pressure-head for this circuit is found, with reference to the center of the heater, as follows:

Pressure caused by water in return riser:

10 ft. @ 194.3°	= 602.5	
10 ft. @ 189.5°	= 603.7	
10 ft. @ 184.8°	= 604.7	
5.7 ft. @ 180.0°	= 345.3	2156.2
Pressure caused by water in flow riser		
35.7 ft. @ 200°	=	2146.3
Difference		9.9 lbs. per square foot

This difference is equal to a pressure-head of $9.9 \times 12{,}000 \div 60.36$, or 1968 m. i. of 190° water.

The pressure-head for Circuit 1 is 1968 — 1590, or 378 m. i. larger than that for Circuit 2.

Circuit 1 coincides with Circuit 2 from the heater to Point 29 and from Point 41 back to the heater; it differs from it only in the sections located between Points 29 and 41.

To design Circuit 1, it is only necessary to design the sections located between Points 29 and 41 so that the friction-head in those sections will be 378 m. i. larger than the friction-head in the corresponding sections of Circuit 2. It appears from "Table for Circuit 2" that this partial friction-head of Circuit 2 is 118 + 139 + 54 + 54 + 54 + 82 + 183 + 173, or 857 m. i. The corresponding friction-head in Circuit 1 must be 857 + 378, or 1235 m. i. We may now design those sections of this circuit as shown by "Table for Circuit 1."

TABLE 1 DENSITY OF WATER AT VARIOUS TEMPERATURES*

(According to Thiesen, Scheel, Dieselhorst, Hirn, Ramsay & Young and others.)

Temp. Deg. F.	Density, Pounds per cu. ft.	Temp. Deg. F.	Density, Pounds per cu. ft.	Temp. Deg. F.	Density, Pounds per cu. ft.
32	62.42	90	62.12	150	61.20
34	62.42	92	62.10	152	61.16
36	62.42	94	62.08	154	61.12
		96	62.06	156	61.08
38	62.43	98	62.03	158	61.04
40	62.43	100	62.00	160	61.00
42	62.43	102	61.98	162	60.96
44	62.42	104	61.95	164	60.92
46	62.42	106	61.92	166	60.88
48	62.41	108	61.89	168	60.84
50	62.41	110	61.86	170	60.80
52	62.40	112	61.83	172	60.76
54	62.39	114	61.80	174	60.71
56	62.39	116	61.77	176	60.67
58	62.38	118	61.74	178	60.62
60	62.37	120	61.71	180	60.58
62	62.36	122	61.68	182	60.54
64	62.35	124	61.65	184	60.49
66	62.33	126	61.62	186	60.45
68	62.32	128	61.59	188	60.40
70	62.30	130	61.55	190	60.36
72	62.29	132	61.52	192	60.31
74	62.27	134	61.49	194	60.26
76	62.26	136	61.45	196	60.22
78	62.24	138	61.42	198	60.17
80	62.22	140	61.38	200	60.12
82	62.20	142	61.35	202	60.07
84	62.18	144	61.31	204	60.02
86	62.16	146	61.28	206	59.98
88	62.14	148	61.24	208	59.93
				210	59.88

* Translated and developed from Hutte by the writer

TABLE FOR CIRCUIT 1

Available Pressure-head = 857 + 378 = 1235 m. i.

Section	1,000 B.T.U.	Assumed Feet Elbows	Assumed Diameter In.	Assumed Unit Friction	Assumed Total Friction	Selected Diameter In.	Selected Unit Friction	Total Friction
		13		22	286			286
29–48	42	3	1½	66	198	1½		198
		10		22	220			220
48–50	42	0	1½	66		1½		220
		10		22	220			
50–52	42	0	1½	66		1½		
		10		22	220		6.4	64
52–54	42	0	1½	66		2	23.6	
		4.5		22	99		6.4	29
54–55	42	1	1½	66	66	2	23.6	24
		23		6.4	147			
55–41	42	2	2	23.6	47	2		194
Total					1503			1235

DESIGN OF CIRCUIT 5

We may now proceed to the design of Circuit 5. This circuit is divided into two branches at Point 62. We will designate the branch joining the return main at Point 45 as Circuit 5a, and the other branch as Circuit 5b.

The water flowing from Point 59 to Point 62 is divided at Point 62 into two parts. One part continues straight down the riser and enters the return main at Point 46, the other flows through Radiator 25 and enters the return main at Point 45.

The relative quantities of water flowing along these two paths depend upon the respective friction-heads and pressure-heads of the two paths. We may, therefore, assume the distribution of the water between the two paths and design the pipe sizes accordingly. If our first assumption results in an unsatisfactory relation between the pipe sizes of the two branch circuits, we must make a second assumption and a second design, and repeat this, if necessary, until a satisfactory solution is secured.

Let us assume that the volume of water arriving at Point 62 is divided there into two equal parts and design Circuit 5a accordingly.

To find the pressure-head of Circuit 5a, we calculate the average temperature of the water in Sections 61-62 and 62-66 to be $200 - 20 \times 12 \div 44$, or 194.5°; and the average temperature of the water in Section 63-65 to be $194.5 - 14.5 \times 12 \div 22$, or 186.6°. The average temperature of the water in Sections 65-45 and 46-H is 180°. The pressure-head of the circuit, with reference to the center of the heater, is then found, by assuming that the temperature of the water changes gradually from 194.5° to 186.6° while flowing through Radiator 25 and that the center of that radiator is 1.3 ft. below Point 62, as follows:

Pressure caused by water in return riser,

7 ft. @ 194.5°	= 421.8	
1.3 ft. @ 194.5°	= 78.3	
21.3 ft. @ 186.6°	= 1287.4	
5.7 ft. @ 180.0°	= 345.3	2132.8
Pressure caused by water in flow riser,		
35.3 ft. @ 200°	=	2122.2
Difference		10.6 lbs. per sq. ft.

This difference is equal to a pressure-head of $10.6 \times 12{,}000 \div 60.36$, or 2107 m. i. of 190° water.

The pressure-head for Circuit 5a is, accordingly, 2107-1590, or 617 m. i. larger than that for Circuit 2. The two circuits differ from each other only in the part leading from Point 30 to Point 45. The friction-head for this portion of Circuit 2 is, from Table for Circuit 2, 983 m. i. The friction-head for the corresponding section for Circuit 5a must be 983-617, or 1600 m. i.

We may now complete the design of Circuit 5a, as shown in the table. The friction-head for the selected pipe diameter is 1587, or 13 m. i. less than the available pressure-head. This difference is less than 1% of the total pressure-head, 2207 m. i., available for Circuit 5a.

TABLE FOR CIRCUIT 5a

Available Pressure-head = 983 + 617 = 1600 mi.

Section	1,000 B.T.U.	Feet Elbows	Assumed Diameter In.	Unit Friction	Total Friction	Selected Diameter In.	Unit Friction	Total Friction
		18		4.6	83			
30–56	146	1	3½	30	30	3½		113
		12		5.5	66			
56–57	110	0	3			3		66
		18		8	144			
57–58	74	1	2½	34	34	2½		178
		9.5		7	76			
58–59	44	1	2	26	26	2		102
		13		7	91			
59–61	44	2	2	26	52	2		143
		7		7				
61–62	44	0	2		49	1½	23	161
		4		14	56			
62–63	22	9	1¼	36	324	1¼		380
		20		14				
63–65	22	0	1¼		280	1¼		280
		4		14	56			
65–45	22	3	1¼	36	108	1¼		164
Total					1475			1587

DESIGNING CIRCUIT 5b

We may now design Circuit 5b with reference to Circuit 5a. These two circuits differ from each other only in the part leading from Point 62 to Point 46. The average temperature of the water in Section 62-67 is 194.5°; in Section 67-46 it is 180°. The pressure-head for Circuit 5b is found as follows:

Pressure caused by water in return riser,

7 ft. @ 194.5° = 421.8

14.6 ft. @ 194.5° = 879.7

13.7 ft. @ 180.0° = 829.9 2131.4

Pressure caused by water in flow riser,

35.3 ft. @ 200° = 2122.2

Difference 9.2 lbs. per. sq. ft.

This difference is equal to a pressure-head of 1829 m. i. of 190° water. The pressure-head for Circuit 5b is, therefore 2107-1829, or 278 m. i. smaller than that for Circuit 5a, and the path leading from Point 62 to Point 46 in Circuit 5b must be designed so that its friction-head is 278 m. i. smaller than that in the corresponding portion of Circuit 5a. The friction-head in this part of Circuit 5a is, from the tables for Circuits 5a and 2, 380 + 280 + 164 + 125, or 949 m. i. The corresponding friction-head in Circuit 5b must be 949 — 278, or 671 m. i., and the design of this circuit is completed as shown in "Table for Circuit 5b."

The first trial calculation demonstrated that it was necessary to use 1¼-in. pipe, supplemented with a short piece of 1-in. and it was decided to insert the 1-in. pipe in the horizontal run which connects the return riser to the return main at Point 46. In this way it was possible to make the friction-head practically equal to the available pressure-head. The insertion of the short piece of 1-in. pipe has the same effect as the insertion of a partially-closed valve.

TABLE FOR CIRCUIT 5b

Available Pressure-head = 671 m. i.

Section	1,000 B.T.U.	Feet Elbows	Assumed Diameter In.	Unit Friction	Total Friction	Selected Diameter In.	Unit Friction	Total Friction
		14.5		14	203			
62–67	22	0	1¼	36		1¼		203
		10		14	140			
67–X	22	1	1¼	36	36	1¼		176
		2		14	28		50	100
X–46	22	2	1¼	36	72	1	110	220
Total					479			699

It is evident that the relation between the pipe sizes for Circuits 5a and 5b is a satisfactory one; hence, the assumption made above, that the water will divide itself into two equal parts at Point 62, is also satisfactory.

Having completed the design of the flow riser, of the flow and return mains, and of a sufficient number of the return risers, we may proceed to the design of the radiator connections and of the radiators. To demonstrate the method, we will design Radiators 1, 26, 24 and 25, and their connections.

DESIGN OF RADIATOR CONNECTIONS

Before beginning the design proper, we must note that in a system having one-pipe return risers, like the one under consideration, each radiator, together with its connections to the return riser, forms a small and independent heating system, and we must study the factors which affect the circulation through the radiators. Let us pursue this study with special reference to Radiator 1, connected to the first return riser at Points 47 and 48. There are four factors influencing the circulation through this radiator, namely:

(A) The pressure-head of Circuit 1, which causes flow from Point 47 to Point 48 through both paths connecting these two points.

(B) The pressure-head of Radiator 1, which results from the cooling of the water in this radiator and which causes water to flow from Point 47 to Point 48 through the radiator and tends to cause it to flow from Point 48 to Point 47 in the return riser.

(C) The friction-heads in the two paths connecting Points 47 and 48.

(D) The inertia of the water at Point 47, which

tends to hold the water to the straight path down the return riser to Point 48, and thereby tends to prevent flow through the radiator.

These four factors will be considered separately.

(A) THE PRESSURE-HEAD OF CIRCUIT 1

Points 47 and 48 are connected by the direct path along the return riser and by the longer path through the radiator. Of the water reaching Point 47, a part will take the direct path to Point 48 and the remainder will follow the longer path through the radiator. These two fractional volumes of water are so related to each other that the friction-heads in the two paths are equal, for, if the friction-head in one path were smaller than that in the other, an additional quantity of water would be immediately diverted to the less difficult path.

The combined quantity of water flowing through the two paths is such that the friction-head from Point 47 to Point 48 is equal to the pressure-head available for that portion of Circuit 1. This available pressure-head is 22 m. i. per foot of 1½-in. pipe (see "Table for Circuit 1"). The corresponding velocity-head is about 8 in. per second. (See Diagram II, THE HEATING AND VENTILATING MAGAZINE for January, 1924).

The length of the direct path, down the return riser, joining Points 47 and 48, is 2.6 ft.; the total available pressure-head is, therefore, 2.6×22, or 47 m. i.

The path through the radiator, joining Points 47 and 48, consists of 2.4 ft. of pipe and 13 elbow equivalents. Let us assume the diameter of the pipe to be 1¼-in. and the velocity of water in the pipe to be 2 in. per second. The friction-head in this path would then be $2.4 \times 2 + 13 \times 4.5$, or 63 m. i. It is evident, from Diagram II and from the calculations above, that the velocity in the return riser between Points 47 and 48 must be slightly higher than 8 in. per second, in order that the friction-head in the direct path may be equal to that in the path through the radiator.

The relative quantities of water flowing through the short and long paths will then be to each other as 2/96.28 is to 8/70.73, or as 208 is to 112. In other words, about 35% of the water would take the path through the radiator and about 65%, the direct path. Since this calculation was based on assumed velocities causing a friction-head of 62 m. i. in each of the two paths and since the available pressure-head is only 59 m. i., the assumed velocities are slightly higher than the velocities which would be attained, but the relative quantities of water flowing through the two paths would remain practically unchanged. If, however, a 1-in. pipe were used for the radiator connections, instead of a 1¼-in. pipe, the relative quantity of water flowing through the radiator would be reduced from about 35% to about 12%.

The division of the flow of water discussed above is independent of the position of the radiator and independent of the direction of flow; i. e., it would be the same whether the radiator is in a vertical or in a horizontal position and whether the direction of flow is from Point 47 to Point 48 or the reverse.

(B) THE PRESSURE-HEAD OF THE RADIATOR

As the water flows through the radiator, it loses a part of its heat and its temperature is correspondingly lowered, so that a column of water in the radiator weighs more than the corresponding column of water in the return riser. The difference in pressure caused by these two columns of water produces and maintains circulation through the radiator in the manner described for the elementary heating system illustrated in THE HEATING AND VENTILATING MAGAZINE for January, 1924.

For example, if the water enters Radiator 1 from Point 47 at 200° and is discharged from the radiator to Point 48 at 180°, the mean temperature of the water in the radiator is about 190° while the mean temperature of the water in the return riser, between Points 47 and 48, is practically 200°. The pressure-head corresponding to these temperatures is, from Diagram II, 46 m. i. per foot, or, for a column equal in height to one-half the distance between the tappings of a 38-in. radiator, it is 1.3×46, or 60 m. i., or practically equal to the pressure-head available for the return riser between Points 47 and 48, as explained above. If the flow of water through the radiator is so slow that the water will be cooled during its passage through the radiator from 200° to 160°, the corresponding pressure-head would be increased to 117 m. i.

(C) THE FRICTION-HEADS IN THE TWO PATHS

This factor has been sufficiently discussed above, under A and B, to explain its effect. Attention might be called here to the practice, sometimes employed, of increasing the friction in the direct path by using a smaller pipe for this section or by inserting fittings which create additional friction. Also to the practice of increasing the length of the direct path in order to increase its resistance. Some engineers never make this path shorter than 5 ft., particularly when forced circulation is employed.

(D) THE INERTIA OF THE WATER

As a given particle of water reaches Point 47, it is flowing with definite velocity and in the direction of the riser, and it will require a certain force, or pressure-head, to deflect it into the radiator connection. It is evident that the force necessary to deflect the particle of water in this manner increases with the velocity of the water in the riser and that it decreases with the angle between the riser and the radiator connection; i. e., for a given velocity in the riser, a given force, or pressure-head, deflects more water into the radiator connection if that connection is by means of a 45° Y than if it is by means of a tee, and that, for a given radiator connection, a given force will deflect more water into the same if the water is flowing in the riser with a low velocity than when it is flowing with a high velocity.

It is difficult to calculate the pressure-head necessary to deflect a given quantity of water, in a given time, from the riser into the radiator connection;

this force will be considered with the force which is necessary to overcome the friction existing at the entrance to the radiator connection. The sum of the two forces must be determined experimentally.

Practically, we may conclude that, for the low velocities which generally obtain in gravity-flow systems, the radiator connections may be made with tees, but for the high velocities which may exist in forced circulation systems the connections should be by means of 45° Y's, set so as to facilitate flow from the riser into the radiator and from the radiator back into the riser.

In the actual design of a heating system, it is evidently impracticable to include all four factors in the calculations because that would make the work too difficult.

The writer believes that Factors A and D may be disregarded in designing gravity circulation systems. Factor A, because the resulting error is on the side of safety, so far as circulation through the radiator is concerned and Factor D, because its effect is small for the low velocities obtaining in gravity-flow systems and because the resulting error offsets, in part, the error caused by the omission of Factor A. Neglecting these two factors, we base the design of the radiator connections on the pressure-head caused by the cooling of the water in the radiator and on the friction-head of the radiator circuit, and proceed as follows, for Radiator 1.

Assume a temperature drop through the radiator of 20°; the pressure-head will be 1.3×46, or 60 m. i. Try 1-in. connections. The path from Point 47 to Point 48, through the radiator, consists of 2.4 ft. of pipe and 13 elbow equivalents. The radiator is to dissipate 12,000 B.T.U. The friction-head is, from Diagram II, $2.4 \times 17.5 + 13 \times 34.5$, or 490 m. i. The 1-in. connection is entirely too small for the assumed conditions. Try a 1¼-in. connection. The friction-head is $2.4 \times 4.6 + 13 \times 10.8$, or 142 m. i. This connection is also too small, and we will try a 30° temperature-drop with a 1¼-in. connection.

The mean temperature of the water in the radiator will be 185°, and the pressure-head will be 1.3×61 or 79 m. i. The friction-head will be $2.4 \times 2.1 + 13 \times 5$, or 70 m. i., or slightly less than the available pressure-head. We may assume then that the temperature-drop through the radiator will be 30° or slightly less when the radiator is dissipating 12,000 B.T.U. per hour and is connected to the return riser with 1¼-in. pipe.

The correct size of the radiator is then found as follows: The mean temperature of the water in the radiator being about 185°, the mean temperature difference, water to air, is 115°; the value of k, for a 38-in., 3-col. radiator is, from Fig. 3, 1.32; and the required radiator surface, $12{,}000/1.32 \times 115$, or, 79 sq. ft. We would select a 16-section radiator; it has 80 sq. ft. of heating surface.

Next, let us design Radiator 26 and its connections. In this case, the return connection to the return riser has been dropped 24 in. in order to increase the pressure-head forcing water through the radiator.

Try a 20° temperature drop and a 1¼-in. connection. The pressure-head of the radiator will be $1.3 \times 46 + 2 \times 90$, or 240 m. i. The friction-head will be $4.4 \times 3.2 + 13 \times 7.6$, or 113 m. i. The 1¼-in. pipe is too large; however, a calculation will show that a 1-in. pipe would be considerably too small. Try a 10° temperature-drop and 1¼-in. connections. The pressure-head will be $1.3 \times 22 + 2 \times 46$, or 119 m. i. The friction-head will be $2.4 \times 12 + 13 \times 30$, or 419 m. i. Proceeding as explained in THE HEATING AND VENTILATING MAGAZINE for January, 1924, we find that Radiator 26 will dissipate 10,000 B.T.U. with a 16° temperature-drop and 1¼-in. connections. The mean temperature of the water in the radiator will be about 187°; the temperature difference, water to air, 117°; the value of k, 1.32; the radiator surface, $10{,}000/1.32 \times 117$, or 65 sq. ft. We would select a 13 sec., 3-col., 38-in. radiator.

RADIATOR 24

This radiator differs from Radiator 26 principally in the substitution of a pipe coil for the cast-iron column radiation.

The radiator is to dissipate 12,000 B.T.U. per hour. Let us select a 1½-in. pipe for the coil and try a 20° temperature-drop. The mean temperature of the water in radiator-coil will be about 190°, and the temperature difference, water to air, 120°. Assuming the value of k for the coil to be 2.6, we find the required coil pipe length to be $12{,}000 \times 2.01/120 \times 2.6$, or 77.4 ft.

Building the pipe coil as shown in Fig. 15, the radiator and its connections to the return riser consist of 82 ft. of 1½-in. pipe and 13 elbow equivalents. Its friction-head is

$$82 \times 10 + 13 \times 5.7, \text{ or } 238 \text{ m. i.}$$

The available pressure-head is $0.5 \times 46 + 2 \times 90$, or 203 m. i.

Since the friction-head is about 17% larger than the available pressure-head, we will try a 30° temperature-drop and find a friction-head of $82 \times 1.1 + 13 \times 26$ or 124 m. i., and a pressure-head of $0.5 \times 68 + 2 \times 132$, or 296 m. i.

Proceeding as explained above, we find that the radiator will operate with a temperature-drop of 24° when it is dissipating 12,000 B.T.U. and is being supplied with 200° water.

The mean temperature of the water in the radiator will then be about 188°; the temperature difference, water to air, will be 118°; and the length of coil pipe should be about $77.4 \times 120/118$, or 79 ft.

RADIATOR 25

This radiator differs from Radiator 24 by the use of branch tees and by the fact that all water circulating through Return Riser 5a flows through the radiator. The flow of water through the radiator is determined entirely by the pressure-head of the circuit in which the radiator is located, and the design of the radiator involves only the determination of the heating surface so that the radiator will dissipate 12,000 B.T.U. when the mean temperature of the water in the radiator is $(194 + 186)/2$, or

190°. The design of the radiator connections requires only the selection of pipe sizes such that the friction-head in the radiator and radiator connections will not differ materially from that assumed in the design of Circuit 5a.

Selecting 1½-in. pipe for the heating coil, the required length of pipe is 12,000 × 2.01/2.6 × 120, or 78 ft. The radiator may be built of six 1½-in. pipe lines, 12 ft. long, two branch tees, and the necessary connections to the riser.

The friction-head consists of the friction-head in the six pipe lines, in the two branch tees, and in the two connections. The calculation of the friction-head in the branch tees and connections must be based on a heat flow of 22,000 B.T.U. with a 20° temperature-drop. The calculation of the friction-head in the six long pipes must be based on a heat flow of 22,000/6 B.T.U. and a 20° temperature-drop; but only for one of the six pipes because the pressure-head which forces one-sixth of the volume of water through one of the six pipes will also force an equal volume through each of the other five.

The friction-head for the two branch tees and connections is caused by 5 ft. of 1¼-in. pipe and 8 elbow equivalents and is 5 × 14 + 8 × 36, or 358 m. i. The friction-head in the six pipes is caused by 12 ft. of 1½-in. pipe and 5 elbow equivalents and is 12 × 5 + 5 × 1.5, or 14 m. i. (practically negligible). The total friction-head in radiator and connections is 362 m. i. The friction-head allowed for Section 62-63 (see Table for Circuit 5a) was 380 m. i. The agreement between the two values is sufficiently close, and the radiator and connections may be constructed as designed.

The next section will describe the design of a one-floor system; i. e., a system in which the heater and radiators are located on the same floor. This system is known in Continental Europe as the Etage-system; its principal counterpart in the United States is the Arcola system, produced by the American Radiator Company.

Insulation of Roofs to Prevent Heat Loss and Condensation

(*Continued from Page 51*)

Start on the left vertical scale of the chart at 40% relative humidity and follow horizontally to the right to the intersection with the Humidity Curve. Then follow vertically up to the intersection with the degree heat head line of the problem, which is 100°. Now from this intersection draw a line through the lower-left hand corner of the chart or "zero" and note the point of crossing of the curve RR. Then read horizontally to the right the resistance (approximately 3.0) as shown by the right vertical scale which is the total roof resistance required to prevent condensation on the under side of the roof.

This problem can be reversed as follows:

Given a roof with a resistance of 3.0, what is the greatest relative humidity that can be carried under the roof with a heat head of 100° before condensation will occur at a room temperature of 70°?

On the Roof Resistance Curve RR locate a point at a height of 3.0 by the resistance scale on the right-hand side of the chart. Draw a line from this point through the lower left-hand corner A. Where this line intersects the horizontal line of 100° heat head, read vertically downward to the humidity curve of the chart. Then pass horizontally to the left-hand edge of the chart where we find that the roof will support a relative humidity of approximately 40% maximum, at 70° inside temperature.

(*This problem and a new method of applying insulation will be discussed next month*).

Home-Study Course in Gravity Steam and Water Heating

(*Continued from Page 56*)

Work Problem No. 47

Experiments have been conducted to determine the in-leakage of air for various conditions of construction, temperature and wind-velocity. Some of the results obtained by one investigator are given in Tables 18 and 19.

Table 18 shows the leakage in cubic feet per minute for the whole window and per lineal foot of cracks for two wind velocities of 14.4 and 24.9 (approximately 15 and 25) miles per hour, respectively. The effect of weather-stripping is apparent by noting that for a plain window with crack varying from 1/16 to 1/4 in., the leakage was 46 cu. ft. per minute while for two different types of weather stripping it varied from 9 to 18 and 7 to 10 cu. ft. per minute, respectively. Heat loss is given for two temperature differences of 0° and 70° F. and for 20° to 70° Ft.

Work Problem No. 48

Table 19 shows the leakage in cubic feet per hour per foot of crack per mile of wind velocity for a plain frame window and also for a frame window fitted with two types of weather-stripping. Leakage is given for various cracks around sash perimeter and also for various clearances between the sash and the stop and parting bead. It will be noted that for a plain window having a clearance of 3/32 in., the leakage in cubic feet per hour per foot of crack per mile of wind velocity is 8.9 and the heat required for a 70° F. temperature difference is 11.9 B.T.U.

Work Problems Nos. 49, 50 and 51

Lesson No. 4, to appear next month, will cover a consideration of some rule-of-thumb methods for computing heat losses from buildings; their application and comparison with the B.T.U. method; the effect of ventilation on heat losses; ventilation requirements for given standards of air purity and the application thereof to given structures.

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A CORRESPONDENT, in commenting upon our last month's editorial dealing with commission cutting, "free" engineering, and the "loading" of heating and ventilating contracts, draws the inference that the term "free engineering" is ambiguous, as it may mean either the lowering of percentages for consulting services or gratuitous service by the manufacturers. We had not thought of it in just that way, but when one comes to analyze the matter, commission cutting may well be considered free engineering to the extent to which the commission is cut. Why not? And the parties who are the recipients of this gift are the architect or the owner, neither of whom gives two whoops whether the heating and ventilating profession is helped or hindered by the transaction.

As our correspondent states, commission cutting is a sad affliction indeed and a hard problem to solve. It is hard to believe that any engineer with a broad, economic vision could be so short-sighted, and he adds, "perhaps the fostering of a Student Heating Society throughout the engineering colleges of the country, with the leading heating publications available at club rates, would aid materially in shaping the minds of our future heating engineers."

When it comes to the matter of "free engineering" on the part of manufacturers, more than one correspondent expresses the opinion that this practice is usually the fault of the engineers themselves. In support of this statement, the following case is cited:

"A certain concern marketing a heating appliance had men in the field who were merely salesmen, not sales engineers. With each and every sale was included a neat little booklet imparting all the engineering information necessary to properly install the appliance. However, the particular article was of that stubborn nature which required it to be installed under certain conditions and, when not so stalled, it simply refused to function.

"Several theories regarding the conditions of operation necessary seemed plausible and, accordingly, consulting engineers began to make recommendations that did not conform to the practice and recommendations of the manufacturer's engineering department. The result was a number of unsatisfactory installations.

"To maintain their prestige and good name, the manufacturers immediately prevailed upon their salesmen to advise the consulting engineers that all recommendations should conform to those in their instruction book. The salesmen, of course, conferred with the consulting engineers but the engineers, being well versed in technical terms, began to evolve theories and recite 'ifs' and 'ands' until the mere salesmen were bewildered and were convinced that the consulting engineers knew more about their product than the company which made and developed it.

"The result was that the concern was compelled to employ sales engineers and technical men who could intelligently advise and superintend the installation of their product."

"Free engineering," concludes our correspondent, "—yes, perhaps it is, to the purchaser of the equipment or the architect, but somewhere along the line some engineer is being paid for doing the engineering work. He should be made to feel that he is doing his profession an injustice if he prefers to work for and be paid by the manufacturer."

It is apparent that the subject is a live one and the discussion of it far from being exhausted. We should be glad to receive additional views and comments from our readers on any phase of the matter that may appeal to them, for there can be no question that we have here one of the things that is gnawing deep into the vitals of the profession and which seems to be getting worse, rather than better.

THE present seems an appropriate time to repeat some comments on commission cutting, made by a close observer of conditions over wide sections of the country. Commission cutting, as he expressed it, is a disease resulting from an attitude of mind. The engineer who cuts commissions is like a guest at a banquet where enough is provided for all. His fear that he won't get his share makes him start to grab, instead of waiting to be served. In the riot which follows, what was an ample sufficiency is wasted to a woeful lack. And everyone suffers because of the lack of control in the man who started the riot.

He goes further. "The disease of commission," he declares, "can be instantly stamped out. It requires no code of ethics, no laws, no supervisory commissions. It requires only that each and every engineer appoint himself a committee of one to govern his own conduct.

"Let's stop it now!"

National Warm-Air Heating and Ventilating Association

Warm-Air Furnace Men Dedicate Their Heating Research Residence

Your presence is requested
at the
Formal Dedication
of the
Warm Air Heating Research Residence
erected by the
National Warm Air Heating and Ventilating Association
in cooperation with the
University of Illinois
to be held in
Urbana, Illinois
December second 1924
at ten-thirty a.m.

Dedicated to Education
in the
Scientific Heating and Ventilating of Homes

Invitation to Dedicatory Exercises

WITH impressive ceremonies and in the presence of a notable gathering of men interested in warm-air furnace heating, the new Heating Research Residence of the National Warm-Air Heating and Ventilating Association in Urbana, Ill., was formally dedicated December 2, last Immediately following the dedication exercises the party inspected the residence which, from this time, will be given over to tests, under ordinary living conditions, connected withe the operation of the warm-air furnace system with which the building is equipped. The testing program, as already planned, is expected to furnish a wealth of important data on such important points as the effect of wind, the relaair, the significance and proper pertive value of inside and outside centage of relative humidity in the house, the variation of air temperatures from floor to ceiling in actual rooms with different air temperatures at the registers, the importance of constant temperature both day and night and the relative value of inside as compared with outside chimneys.

Other items on the testing program include the proper location of furnace with respect to center of basement, the relative value of return air ducts above the floor compared with ducts below the basement floor, the proper location and number of recirculating registers, the effect of various installation details on operation of wall stacks to upper floors, the effect of various installation details on operation of basement pipes, the problem of the remote room or the room with three sides exposed, and the proper installation for a sun porch.

DEDICATION FEATURE OF FURNACE MEN'S MEETING

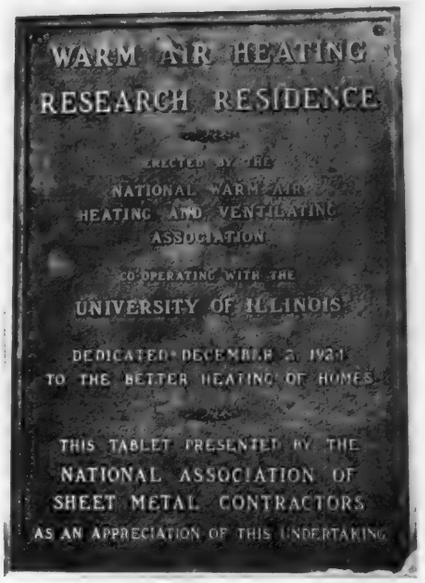
The dedication and inspection were easily the outstanding features of the mid-year meeting of the National Warm-Air Heating and Ventilating Association, which was held in Urbana, December 2-3. Over 160 members and guests were registered when the meeting was called to order, at the Urbana Lincoln Hotel, by President E. B. Langenberg.

Professor A. C. Willard, who has been so prominently identified with the research work in warm-air furnace heating, conducted for the association at the Engineering Experiment Station of the University of Illinois, addressed the meeting, stating that the occasion could justly be considered a celebration of an accomplishment that stands out as the most constructive effort of its kind rendered by any society or association. The Research Residence, Professor Willard stated, is the result of five years' effort, but an important work still remains to be accomplished in disseminating the results of the experiments at the residence among the installers of heating equipment the country over. The residence heating plant, he said, is a duplicate of the University testing plant so that its performance characteristics are already well known.

The plant is so installed as to permit of its being tested as three different systems: single, multiple and non-recirculating. The testing apparatus also permits of securing temperature readings at every conceivable point and also of obtaining outside temperature readings at any point desired. Temperature readings are also provided for in the flues and flue linings, and they can be made by one person at a switchboard in the basement of the residence. Professor Willard paid a high tribute to Professor V. S. Day, who handled the practical end of the work, and to Professor L. H. Provine, head of the Department of Architecture at the university, whose services in designing the residence were given gratis.

CEREMONIES AT THE RESEARCH RESIDENCE

Following Professor Willard's address the members and guests proceeded in a body to the Research Residence, which bears the number 1108 Stoughton Street. From the steps of the residence, with all in attendance standing on the lawn, President Langenberg introduced the Rev. E. D. Johnson who delivered an invocation. President Langenberg then presented Professor James F. White, who appeared in place of President David Kinley of the University of Illinois and who made the dedicatory address.



Bronze Tablet Placed at Entrance to Research Residence

DEDICATORY ADDRESS

"It is a matter of great pride to us," said Professor White, "that your association should have selected this university as the one best qualified through its facilities, method of organization, and its staff, to render you the kind of service which you were seeking. We knew that we were better able to serve you than any other agency, and we are greatly pleased that you came to the same conclusion.

"One of the series of principles of business conduct formulated at the annual meeting of the Chamber of Commerce of the United States," continued Professor White, "reads as follows: 'Knowledge—thorough and specific—and unceasing study of the facts and forces affecting a business enterprise are essential to a lasting individual success and to efficient service to the public.'

"Any one who has followed your research here at the University of Illinois must realize that the admirable phrasing of this principle by our National Chamber of Commerce is but an expression of a policy established by

your association several years ago, and I congratulate you on being pioneers in recognizing this great principle and in applying it effectively to your business.

"Without being familiar with the specific circumstances which led up to these co-operative investigations I have felt sure of at least three impelling forces: first, you had found out that the competition which your salesmen met with on the outside had to be beaten on the inside; that your article had to be more economical in the long run if not cheaper in first cost, and that you had to be able to show the proofs; second, you realized, as President Roosevelt so aptly put it, that 'every man owes some of his own time to the upbuilding of the profession to which he belongs,' and you are accordingly through the efforts of your organization laying a scientific foundation for your business, and if I interpret the trend of your progress correctly I believe you are making a profession out of what has, for many years, been considered a trade; and third, you realized your obligation to serve the public, to make living conditions more healthful, more comfortable, and more economical.

"The great discoveries of science have usually lain dormant in the annals of scientific societies for many years before their practical application has been discovered. The scientific mind is not usually the type which is interested so much in the practical application as in the discovery of principles. The research staff of this institution must be primarily employed on abstract scientific investigations, because it is through such research that real scientific progress is made; but we have a great variety of investigations now under way, and I am going to digress a few moments to cite a few especially interesting examples.

LOW-TEMPERATURE PROCESS FOR COKING SOFT COAL

"One which has been under way for nearly twenty years is that of a low-temperature process for coking soft coal, discovered by Professor S. W. Parr of our Department of Chemistry. This process makes a fuel from which has been eliminated all of the products which make soot and smoke and all of the incombustible elements and leaves a material with sufficient volatile matter so that it will burn readily, even in an open grate. This investigation has been carried about as far as it can be in our university laboratories and we now need outside assistance to develop the products to the commercial stage.

"After you gentlemen have carried your investigations in furnace construction and plan efficiency to a conclusion, the coal-burning furnace will still be objected to because of the dirt necessarily involved in its operation. It seems to me that before you have finally solved your problem of making the warm-air furnace an ideal home-heating device, that you must help us in putting Professor Parr's coke on the market. This investigation started some twenty years ago at the time of the anthracite strike in Pennsylvania when the Illinois coal was shipped into the East and it was discovered that it could not be used in their furnaces. Professor Parr thought that Illinois coal could be prepared so as to solve their problems and I hope that many of you while here will have an opportunity to see the product which he has evolved.

"All materials are being standardized. The architects no longer have to specify the qualities of cement and steel in detail. They merely prescribe that they must comply with certain standard specifications.

"May we look forward to the time when in specifying a furnace we will get the best results for our client by specifying that the house shall be heated by a type H furnace installed in accordance with layout No. 365 which installation shall be guaranteed by the contractor to perform up to Schedule A-11, all references being to the standards of the National Warm-Air Heating and Ventilating Association, and further, that the job will be accepted upon presentation to the architect of a report of a test made by an engineer of said society certifying that the job complies with the specifications and that the costs of said test have been paid for by the contractor.

"This may sound facetious but many an architect has been responsible for building a furnace-heated home with-

Members and Guests of National Warm-Air Heating and Ventilating Association Assembled for Dedication of Warm-Air Heating Research Residence, at Urbana, Ill., December 2, 1924

out knowing anything more about the job than he would under the procedure suggested above.

"Therefore, I hope you will find a way to train the architects to intelligently apply the principles which you are going to discover and so make them worthier members of their great profession.

"But remember that even if all goods could be standardized and could be specified by groups, that the value of an article will still depend on the intent to serve which prevails in the organization behind the goods.

"And may I also venture a word of appreciation on behalf of the householder.

"I began to fire the furnace in my family home almost fifty years ago. It was a splendid brick-set furnace and none of the air was recirculated.

"All the succeeding furnaces that I have had to deal with were subject to the usual ails that made folks adopt steam or hot water heat when they could afford it, until I reached the place in my career when I began to design houses and install furnaces in them, and I found that the public's lack of appreciation of what could be accomplished with warm-air heating was the stumbling block in the way of their getting it and that when they found out what they ought to expect of a furnace there were men in the business who could give them a satisfactory job, not as efficient as it might be, nor as economical but the air was not overheated, there were no uncomfortable drafts, the variation between floor and ceiling temperature was not extreme, moisture was often added to the air, and the plant was acclaimed a success.

Now you are studying economy and efficiency and questions of health and I don't know of any human problem, improvements in which will be so great a boon to so large a per cent of the human race. Much is expected of you. John Wanamaker said, 'It is not the leap at the start, but the steady going on that gets there.' You took the leap and then went steadily on, and the additional facilities which you have added in this house we dedicate today insure your carrying this work to a fitting climax."

President W. C. Markle, of the National Association of Sheet-Metal Contractors, who spoke next, paid tribute to Harry Hussie of Omaha as the father of the recent progressive movements in the warm-air furnace heating industry. He emphasized the importance of educating home owners in the use of what he termed the "steering equipment" of their furnaces, namely, the dampers. President Markle likened the work of the association to that of the hardy pioneers who opened the West for its vast development and he stated that the Research Residence was a pioneer effort that would result in untold accomplishments and progress for the industry and mankind.

At the conclusion of his address President Markle unveiled a bronze tablet at the left of the residence entrance, a gift of appreciation and tribute from the National Association of Sheet-Metal Contractors to the National Warm-Air Heating and Ventilating Association. President Langenberg accepted the tablet on behalf of the association and expressed his appreciation of the co-operation existing between the two organizations.

Secretary F. C. Houghten, of the American Society of Heating and Ventilating Engineers, acting for President Homer Addams, of that society, presented a visitors' register on behalf of his society, whereupon Professor Day presented the key of the residence to President Langenberg. After unlocking the door, Mr. Langenberg stated that the key would be thrown away since the house henceforth was to be open to the world.

A group photograph was taken of the party. Those present then entered the residence and signed the register. Inspection of the residence revealed it to be most homelike and furnished in excellent taste, for which the association found itself indebted to Mrs. A. C. Willard, under whose direction this part of the work was carried out. The spacious living room was enhanced with a large floral piece, the gift of the Langenberg Manufacturing Company. A canvas of the residence, painted by Clarence H. Kissinger, hung over the fireplace. The nucleus of a splendid library was found in the living room with a table having leather binders for the *American Artisan*, *Furnaces and Sheet Metals*, THE HEATING AND VENTILATING MAGAZINE and the A. S. H. & V. E. Guide, together with several textbooks on heating and ventilating subjects. A scroll of the members contributing to the residence hung on one of the walls.

On the same floor is located the office of the residence, with portraits of the past presidents of the association on the walls. The guest register is located in the sun parlor. The rest of the floor is given over to a dinette and kitchen.

On the second floor are located the custodian's room, a committee room, research staff room and a bath. Two dormitories and bath are on the third floor.

From a technical standpoint the chief interest centered in the basement. An instrument board located near the heater carried a Hays CO_2 draft recorder for recording the CO_2 in the flue gas, a Republic flow meter for recording chimney draft, a Taylor pressure gauge and two Ellison inclined draft gauges for reading draft differential through the furnace and in the smoke pipe.

Also located in the basement is a switchboard equipped with 105 switches and designed as a thermocouple central station. The switches can be connected at any of the many points in the residence and the temperatures at that point determined by means of a potentiometer located on the board. A reading on this instrument is compared with a calibration curve and the temperature thus made available. An illustration was that of a reading of one millivolt which corresponded to 110° F. Thermocouples are imbedded in the walls throughout the residence, while the committee room has one wall in which is a panel for removing and changing the wall stacks when desired.

Afternoon Session, December 2.

The remaining sessions of the meeting were held at the Urbana Lincoln Hotel. At the Tuesday afternoon session, President Langenberg gave an interesting review of the history of the association from the time of the Federal Furnace League in 1914. He told how the laboratory idea was suggested and of the acrimonious discussion which developed as to whether a university professor could be of any value to the industry. Events since then, he stated, have proven conclusively the sagacity of the action taken which, he said, was greatly influenced by W. G. Wise whose contention was that a university would give an unbiased service which could be obtained from no other agency.

He then told how the present Standard Warm-Air Heating Code was undertaken under the administration of Past President Jones and of how twelve years elapsed before the code was finally drafted and put through by committees of six men from four associations. He reminded his hearers that it was only at the December, 1923 meeting that it was decided to proceed with the construction of the Research Residence. He felt that the next big task ahead is the designating and rating of warm-air furnaces.

For the Joint Code Committee Professor J. D. Hoffman stated that about two years ago the first draft of the code was made and only recently the third edition of the code was published. The demand for the code he interpreted as evidence of the great interest in the rules given and need for them. He then presented a compilation which he had made of a brief specification covering the points of owner's responsibility, heating contractor's responsibility, co-operation and guarantee, which the architect could include in his complete specification.

The guarantee suggested in the report was that the heating contractor should assume a guarantee of heating each room to 70° F. average with zero outside "provided the user follows the directions for operating the furnace, and provided the heater is connected to a chimney or proper construction and capacity." The substance of the specifications as suggested was accepted by the meeting.

For the Educational Publicity Committee, Chairman E. F. Glore reported that but little as yet of the $2500 appropriation for the Publicity Bureau had been used since no large program had been adopted as yet. In pursuance of the present plan a newspaper man has been retained to syndicate to newspapers all over the country articles on the value and benefit of warm-air heating, the articles to be prepared

from matter furnished by members of the association.

Mr. Glore urged as an association slogan, "A warm-air heating system is best for the average home," and asked the members to incorporate it in their stationery and advertising matter. Mr. Glore displayed a map showing that most of the association's members are located in the central west and eastern states. In concluding his report, Mr. Glore mentioned the apprenticeship work of the plumbing industry and declared that the furnace industry would soon have to proceed to secure more dealers and apprentices. The session concluded with the report of the executive committee, made by Chairman I. L. Jones. The report suggested an amendment to the constitution which would permit of associate membership in the association at an annual fee of $10.00. In the discussion it was brought out that many times architects, engineers, contractors and others have asked for some sort of membership so as to receive the *Bulletin* and other association publications. The report was adopted.

Morning Session, December 3.

The Wednesday morning session was held in the Engineering Lecture Room of the university. Dean Ketchum explained the importance and volume of the research work at the laboratory. The university, he explained, will take no commission for research on a co-operative basis unless the work is to benefit the public. No purely commercial commissions are accepted. Dean Ketchum urged the exercise of care in interpreting the research bulletins of the university since from time to time certain parts are lifted out and used in error. All of the bulletins, he said, are thoroughly censored and checked by the complete staff before being released and are entirely free from commercial bias.

Professor Willard, in a talk at this session, outlined the furnace research work which has been conducted. He used a number of slides of curves which illustrated the results obtained to date. He was followed by Professor U. S. Day who reviewed the tests showing influence of length of header on the heating effect at the register in a gravity circulating warm-air furnace system, tests of two registers of different sizes but equal areas and tests on reducing area of register face by blocking off lower part of register face. Professor A. P. Kratz reported on the tests on the performance of a cast-iron crab radiator furnace and on a comparison of tests on three types of furnaces.

The concluding paper of the meeting was by Professor A. C. Willard on "Rating the Warm-Air Furnace."

The Association Banquet

Dean Ketchum of the College of Engineering and director of the Engineering Experiment Station at the University of Illinois was the principal speaker at the association's banquet which was held Tuesday evening, December 2, at the Urbana Lincoln Hotel. President Langenberg acted as toastmaster. Dean Ketchum said, among other things, that the work of the association was a movement of the kind which helped to make a profession of business and to that extent would help business to function in helping mankind by co-operative effort, very much as the medical and other professions do at present.

Other speakers were W. D. Cover, who predicted a great expansion of the warm-air furnace industry; John H. Hussie, whose subject was, "Selling the Idea of Research to the Installer;" President W. C. Markle, of the National Association of Sheet Metal Contractors; Mrs. Laura B. Evans of the university, and Messrs. Pearson, Scott, James, Harms and Symonds, also Professor Provine.

American Society of Heating and Ventilating Engineers

Ontario Chapter Discusses Oil Burning

UNDER the title of "The Use of Fuel-Oil in Commercial and Domestic Heating Plants," Lionel L. Jacobs, manager of the Fess Oil Burner Co., of Canada, gave an interesting account of the development of fuel-oil heating and the present status of this industry as applied to conditions in Canada, before the Ontario Chapter, A. S. H. & V. E., at its December meeting in Toronto, December 8.

Discussing first the various types of fuels he said:

"For fuel purposes we have two main types: Tar and tar oils and petroleum oils. As tar products at the present time have a ready market at prices considerably higher than could be obtained for them as fuel, we can disregard them except to note that tar itself and all distillates with proper means to keep them liquid, and also with proper types of oil burning equipment can be used efficiently.

"I have, in fact, even burned soft pitch, but it is extremely troublesome and only very low efficiencies were obtained.

"Crude petroleum, while varying considerably in its characteristics, may be divided into two distinct types: Asphalt base and paraffine base, according as the residue on distillation is asphalt or paraffine wax.

"The former comes from California, Mexico or parts of Texas.

"The latter is known more or less as Mid-Continent oil, and comes from Pennsylvania, Ohio, Oklahoma and parts of Texas.

"The Russian, Rumanian and Borneo oils are, I believe, all of the latter type, although I am not quite sure of the Borneo oils.

"Crude oils, except perhaps actually at the oil fields, are seldom used for fuel, primarily because the lighter fractions are too valuable, and, secondly, because with almost all crudes if the lighter fractions are not removed, they lower the flash-point of the oil sufficiently to make them dangerous.

DISTILLATION

"A great variety of fractions are taken in distillation according to local and other conditions, but these fractions may be mainly divided into:

"Gasoline, 58° up.
"Heavy naphtha, 50°–58°.
"Kerosene or coal-oil, 40°–50°.
"Distillate (in U.S.A.), 36°–45°.
"Gas-oil, 32°–36°.
"Light fuel-oil, 28°–32°.
"Medium fuel oil, 24°–28°.
"Heavy fuel-oil or residue, 24° down.

"From kerosene down all these fractions vary in characteristics according as they overlap more or less.

"In Toronto, and in fact anywhere in Ontario, practically nothing but Mid-Continent crude is distilled. All crude, except for a relatively small amount at Petrolia, has to brought in, either in tank cars or pipe lines, and consequently those highest in gasoline are selected and they are almost exclusively paraffine base crudes.

"The consequence is that no really heavy fuel-oil is available in this market, (Canada), the small amount of residue produced being readily disposed of as road oil.

"In Montreal and the province of Quebec where oil can be handled cheaply by water in tank steamers, asphalt-base residues are always available, and provide the bulk of the ore fuel used by steam boats. The gravity of this bunker fuel, ranges from 13° to 18° Bé.

"The heaviest oil available in the Toronto market runs, I believe about 22° Bé.

"Fuel oils vary considerably according to the characteristics of the crudes from which they come. The principal characteristics that we require to note are:

"Gravity, flash point, viscosity, heat value, moisture and sediment, sulphur content."

Speaking of the flash-point of oil or the temperature at which the oil

begins to give off appreciable quantities of inflammable vapor, Mr. Jacobs said:

"Generally the flash-point gets higher as the gravity of the oil gets lower. In 1922 the Fire Underwriters set 100° F. as the lowest flash-point permitted for fuel purposes. Personally, I am very much against the use of oils with flash-points below 125° F. with special equipment, and below 100° F. for normal use.

"One of the great difficulties the oil-burner manufacturer has had to contend with has been the restrictions necessarily imposed as a result of the permission to use 100° F. flash-point oil. If the underwriters had made two sets of regulations, one for equipment being used with oils having flash-points below 150° F., and another with oils, above 150°F., more progress would have been made.

"The flash-points of oils available in this market (Canada) are approximately; Furnace oil (the lighter kind) 160° to 170° F.; medium fuel-oil, around 200° F.; heavy fuel-oils, as high as 370° F. though this is exceptional; more generally, from 200° to 250° F."

Viscosity, or the measure of the internal friction of the liquid, declared Mr. Jacobs, is a most important subject to the user of fuel-oil and to the designer of oil-burning installations. As the temperature increases the viscosity decreases, that is to say, the oil becomes more mobile. Generally, as the gravity decreases, the viscosity increases.

Usually asphalt-base oils are more viscous than paraffine-base oils. There are, however, some striking exceptions to the last two statements.

Mr. Jacobs credited the vaporizer with a very limited, if any, utility. He declared the function of any oil burner is to atomize the oil, so that the oil particles will present the maximum of surface for contact with the air required for combustion. For almost every oil, he said, there is a minimum temperature below which the viscosity is so high that effective atomization cannot be obtained.

Most of the lighter oils are sufficiently mobile at ordinary temperatures, but the majority of the heavy oils and particularly the asphalt-base oils require to be heated to obtain the correct viscosity.

Heating oil to reduce viscosity must be either by steam or by an enclosed electric heater. The underwriters will not permit direct heating. Fuel-oil must never be heated above its flash-point; a few degrees below is preferable. The reasons for this are the danger from the inflammable vapor and the jerky, gusty fire which results.

Some oils will not attain the proper viscosity below the flash-point and these, said Mr. Jacobs, should not be used. The decision as to the correct temperature is a matter of experiment.

"Oils for use without preheating," he said, "should have what is known in the trade as a zero cold test, which means that they are quite free flowing at 0° F."

Where conditions are suitable for preheating, Mr. Jacobs advocated the use of the heaviest oil obtainable, but it often happens that the difficulties and expense of preheating, especially in domestic equipment, outweigh the advantages of increased heat value per gallon.

HISTORY OF OIL BURNING

Mr. Jacobs said that the first record he could find of the use of oil burners was about 1870 in Russia where an oil distiller, swamped with the residue called Astatki from the distillation of crude-oil for kerosene or lamp oil, as it was then called; conceived the idea of using the waste product for the production of steam. The experiment was a success and very soon practically all of the steam power of southern Russia, both for factories and navigation, was raised from this residue.

"From then on until 1898," continued Mr. Jacobs, "there was little progress, but in that year the discovery of oil in Borneo and Texas gave an impetus to the art, and considerable progress has since been made.

"The first equipment was of the steam-atomizing type, undoubtedly a crude affair made up of pipe and tees, much the same as most of us have done at some time or other.

"In America this was the first type of burner, one in which the atomizing agent was steam, and considerable development to reduce steam consumption and increase efficiency was gradually made, but the steam-atomizing burner was limited to large plants where steam for atomizing was always available. The difficulty of starting up, lack of steam, and other considerations led to the use of the same type of equipment with air instead of steam as an atomizing agent.

"Air compressors and blowers came into use and gradually made the use of oil possible on smaller heating plants, where continual shut-downs and low steam pressures made the use of steam atomizing equipments difficult or impossible.

"But air-compressors and blowers were expensive to install, expensive to maintain, and expensive to operate, and finally, in about 1900, a burner was invented that atomized the oil mechanically by throwing the oil by centrifugal force off a rapidily rotating vertical disc.

"This equipment was large, it was noisy, but because it was easy to start and stop, and fairly cheap to install and operate, it enlarged the field for oil burners to include all medium-sized heating plants.

"By changing the disc to a cup, attaching a turbine wheel to it and operating it in the horizontal instead of the vertical plane, the turbine burner was developed, operated by a low-pressure centrifugal blower.

"This burner took care of heating plants where starting and stopping was frequent, but which were too large for the mechanical burner. With this burner a battery of low-pressure boilers could be operated with one or more blowers.

"Oil was used on steam boats. It had many advantages. Storage was simple, loading of fuel was quick and clean. It eliminated labor and increased capacity without increasing size of boilers. But steam-atomizing burners were required to obtain the necessary capacities, and every ounce of fresh water counted, so that the 2% or 3% required for atomization could be ill afforded, and the pressure burner was developed. This burner atomized the oil by releasing it suddenly from a small orifice under very high pressure, 120 lbs. or more.

"This burner was excellent for high capacities, but the efficiency dropped when the volume of oil was reduced, and it was not until comparatively recently, when a burner of this type was designed that by-passed the oil back from the tip of the burner, instead of reducing the volume that high efficiency was maintained with any degree of flexibility in capacity.

"These five types of burners, the steam atomizing, the air atomizing, the mechanical burner, the turbine burner, the pressure burner, (sometimes misnamed a mechanical burner), are the basic types from which all fuel-oil burners of every kind on the market to-day, large and small, have been developed.

"Except in improvement of design and workmanship, these five types as originally produced serve for all commercial installations at the present time.

"In commercial installations I include all steam plants for power and all heating plants with a capacity of over 3,000 sq. ft. of steam radiation.

INSTALLATION MORE IMPORTANT THAN DESIGN

"After the invention of oil burners came the engineer who quickly saw that while to some extent there was a choice of types for any particular installation, high efficiency was much more a matter of design of installation than type of burner.

"Almost every boiler plant presents its own problems, and the peculiarities of the boiler to be equipped have to be co-ordinated with the characteristics of the burner to be used, and if they will not co-ordinate a different type of burner must be selected.

"The majority of installations have had to be made on existing boilers which have had to be adapted as could be best and most cheaply done, and some installations have given poor results because the purchaser would not go to the expense of the changes necessary for the best operating conditions, others because the concern installing equipment did not understand the importance of installation, and expected the burner to give equal results under all conditions when similarly installed.

"On the whole, however, the results have been very fair, and to-day there are very many excellent examples in operation in Canada.

"Probably one of the most outstanding examples in Canada is that of the Ford plant on Danfort Ave., where 3 B & W boilers having a rated capacity of 200 h.p. are being operated at 250% of rating at high efficiencies. In this case the setting of the boilers was designed by the firm which installed the equipment, and the design is a complete departure from previous practice.

"The boilers are set high, and the burners inserted from the rear, so that the whole length of the boilers is available for flame travel. A horizontal baffle is placed between the second and third row of tubes. Except that the first vertical baffle is slightly more inclined, and the second vertical baffle somewhat shorter, the travel of the gases through the tubes is otherwise quite normal.

IMPORTANCE OF COMBUSTION AREA

"The importance of combustion area can not be overlooked. Efficient operation can not be obtained with less than 1 cu. ft. of combustion area per developed boiler horse power.

Another important consideration is to insure as far as possible that incompletely burned fuel does not strike any heat-removing surface.

"Combustion is a process of raising the temperature of the fuel to the point of complete combustion. When the fuel strikes a heat-removing surface, the temperature is lowered, instead of raised, and carbon deposits occur or gases get away to the stack incompletely burned and smoke and consequent heat losses result.

"For this reason in square sectional, and firebox or Kewanee type of boilers where there is insufficient depth to give the necessary flame travel, I have always advocated the use of vertical type mechanical burners in spite of certain disadvantages, and a limited efficiency, and this is also, of course, true of vertical fire-tube boilers.

"Let us now consider the domestic field. As you are aware, due to a great extent to the effects of the great war, in providing other activities for our inventors and in reducing the available supplies of suitable fuel-oil, very little development occurred in the domestic field until within the last six years. The development within this period has been quite considerable, helped not a little by the strike of anthracite coal miners in 1922.

"The problem in the domestic field has been a difficult one. At first, hand-controlled equipment left the operation and adjustment to an erratic unskilled customer. Records of service show as high as 60% due to improper operation.

"The boiler in which installations had to be made was designed for coal. not oil. It was designed to operate with as little attention from the householder as possible. It had a limited combustion area and hardly any depth for flame travel without resultant impinging of incompletely burned fuel against heat-removing surfaces and consequent deposit of carbon and loss of efficiency.

"For these reasons, as with the square and fire-box type of large boilers, I have felt that the only proper type of equipment was the mechanical burner giving a round or saucer shaped flame, and applying the heat in the same manner as the coal for which the furnace was designed.

"However, there have been one or two jet-type equipments that seem to give satisfactory results.

"The advent of automatic operation has greatly helped this situation, as such equipment can be set to give the best results with any particular conditions, and is then not interfered with by the customer, and it is possible that the success of the jet types has been more in the automatic operation (which is easier to obtain in this type) than in the efficiency of operation. There has hardly been time to really tell.

FUNDAMENTALS OF DOMESTIC OIL BURNING

"The fundamentals for domestic use in order of importance seem to me to be: Simplicity of design, quietness in operation, efficiency, automatic action.

"Ignition of automatic equipment has in the past been by means of gas pilot. Now electric ignition, which is undoubtedly ideal, is coming in, but great care needs to be exercised to insure that intermittent lighting can not take place. Already several bad explosions have occurred from this cause. For this reason, until some more positive igniter than the spark-plug type can be found, I am much more favorably impressed with the heating-element type of igniter than with the high-tension spark.

THE NATURAL DRAFT BURNER

"There is one type of equipment that I should say a few words about before closing. I refer to the natural draft burner.

"A number of these have been tried, and the results have been far from satisfactory. Slight changes in atmospheric conditions that reduce the draft, but not the oil supply, cause smoke and carbon.

"It would seem, moreover, that in the vaporization of fuel-oil, there is a temperature apparently just prior to vaporization or just after, when carbon is deposited from the oil, and this invariably results eventually in the choking of the oil supply.

"The heating of the vaporizer or generator prior to lighting has been slow and troublesome, and the constant cleaning of blocked oil-supply lines or generators has made the equipment almost as dirty and troublesome as a coal fire.

"Perhaps a get-at-able equipment will be designed, at present it has not and until that time, in my opinion, this type is hopeless.

"Slightly better success has been found in the States with this equipment where a distillate almost like kerosene can be purchased almost as cheaply as fuel-oil. In Canada such an oil is not available, and coal oil at 18 to 24 cents a gallon is prohibitive."

Group Engineering of Grand Central Terminal Described to New York Chapter

A review of the development of the Grand Central Terminal, in New York, with its numerous apartment and other buildings constructed directly over the tracks of this railroad terminal and which has proceeded to the point where only two building plots are left, was described, from the engineer's point of view, by Clyde R. Place, consulting engineer in charge, at the December meeting of the New York Chapter, held at the Building Trades Employer's Club December 15. Mr. Place's address was devoted largely to the provisions of heating and ventilating this group of buildings, dealing particularly with the forced circulation water heating system installed which has long been known as one of the classical installations of its kind.

At the outset, Mr. Place quoted from one of the early reports on the subject of the required mechanical equipment, made in 1907, to show how impossible it was at that time to gauge the future development of this project. For one thing, the idea at that time was to fill the spaces with "Monumental" office buildings six stories in height, whereas what happened was the erection of apartment and similar buildings, some of which are 28 stories in height.

The fact that most of the buildings were to have no basements available for piping, of course, added materially to the difficulty of the problem. It was decided to place the power plant at some out of the way point, instead of near the center of the load, on account of land values. As matters have turned out the location decided upon, at Fiftieth street has gradually increased in value so that now the proposition has actually been made to sink the power plant far below the surface of the ground.

Of the twenty-five buildings now being served from the power plant, ten are steam heated and fifteen are water heated. Mr. Place described the three-pressure water heating system used in the Biltmore, low pressure, intermediate and high pressure, and of how successfully this arrangement had worked out.

While the original plans contemplated supplying 100,000,000 cu. ft. of building space, the total area was rapidly approaching the 200,000,000 cu. ft. mark. For this reason the development in some respects had long since outgrown its capacity and in several of the build-

ings the refrigerating and compressed air requirements are supplied from individual outfits. The greatly increased heating load had been taken care of by installing stokers to burn the hard coal used and which permits the boilers to be operated at nearly 300% of rating. At the time the plant was installed, said Mr. Place, no satisfactory stoker had been developed for burning hard coal and in those days, the use of soft coal was prohibited.

President William J. Olvany opened the meeting by presenting Homer Addams, president of the American Society of Heating and Ventilating Engineers, who told, among other things, of how impressed he had been, in looking over the early plans of the society, to see how many of its long-cherished aims had been realized. He was followed by Secretary F. C. Houghten who spoke of the three most important matters to come before the society at its forthcoming annual meeting, namely, the proposed heating and ventilating code, the future of the Society's Research Laboratory and the proposed increase in membership dues.

This matter of membership dues came up for further discussion at the close of the meeting through the reading of a letter from H. P. Kahn, chairman of the chapter's Membership Committee, opposing the proposed increase. It was finally voted to submit the matter to the members in the form of a mail ballot to obtain the sense of the membership on the question.

Massachusetts Chapter

T. F. McCoy, manager of the Boston Branch of the Powers Regulator Co., of Chicago, was the principal speaker at the December meeting of the Massachusetts Chapter, held December 8, at the Affiliation Rooms, in Boston. His subject was "The Benefits of Automatic Temperature Control on Daily Lives."

Nomination of Samuel E. Dibble for President

At the instance of members of the Pittsburgh Chapter of the American Society of Heating and Ventilating Engineers, Professor Samuel E. Dibble of the Carnegie Institute of Technology. has been nominated for president of the society. Professor Dibble is now the first vice-president of the society. In a circular to the membership, issued by the Pittsburgh Chapter, it is pointed out that Professor Dibble has served on the society's Research Committee since its organization, then on the council and later as second vice-president and first vice-president. His advancement to the office of president, it is added, "had been generally anticipated throughout the society."

Louis A. Harding of Buffalo was the choice of the society's nominating committee for president, this committee being composed of J. R. McColl, Detroit, chairman; J. D. Cassell, Philadelphia; Roswell Farnham, Buffalo; H. M. Hart, Chicago; and J. C. Hobbs, Pittsburgh.

Tentative Program for Annual Meeting

Additional details of the plans for the forthcoming annual meeting of the American Society of Heating and Ventilating Engineers provide, among other things, for an informal reception and dance on the evening of the first day of the convention in Boston.

In order to comply with the society's charter, it is necessary to hold the business session in New York. This will go on Tuesday morning, January 27, at the Engineering Societies Building, New York. It is hoped to complete this session in time for the members and guests to take the 12 o'clock train for Boston. In that case the party will arrive in Boston in time for dinner, and the evening entertainment, as planned, will be carried out.

Boston headquarters will be at the Copley-Plaza Hotel, within two blocks of the Back Bay station. Following is the schedule for the Boston sessions:

Wednesday morning, January 28. Morning session at 10 o'clock; afternoon session at 2 o'clock and evening session at 8 o'clock. (Copley-Plaza Hotel).

Thursday morning, January 29. Morning session at 10 o'clock. Afternoon sight-seeing trip about Boston and vicinity. Evening: annual dinner of the society at the Copley-Plaza Hotel.

The detailed program is as follows:

BUSINESS SESSION, NEW YORK, TUESDAY MORNING, JANUARY 27

President's address and reports of council, secretary, treasurer and of executive, finance, publication and membership committees.
Report of tellers of election.
New business.
(Adjournment to be taken in time to catch 12 o'clock train to Boston).

PROFESSIONAL SESSION, BOSTON, WEDNESDAY MORNING, JANUARY 28

Address of welcome.
President's address.
Response by Boston member.
Paper: "Heating and Ventilating the Modern Steam Power Station," by Davis S. Boyden and A. B. Williams.
Paper: "Effect of Temperature Upon the Friction of Water in Pipes," by Professor F. E. Giesecke.

PROFESSIONAL SESSION, WEDNESDAY AFTERNOON, JANUARY 28

Consideration of proposed "Code of Minimum Requirements for the Heating and Ventilation of Buildings," L. A. Harding, chairman.

PROFESSIONAL SESSION, WEDNESDAY EVENING, JANUARY 28

Résumé of business session in New York.
Report of technical committees.
Paper: "Industrial Applications of Ozone," by F. E. Hartman.
Paper: "The Use of Owen's Jet Dust Counter and of Electric Precipitation on the Determination of Dusts, Fumes and Smokes in the Air," by Philip Drinker.

RESEARCH SESSION, THURSDAY MORNING, JANUARY 29

Report of Committee on Research, William H. Driscoll, chairman.
Address: "The Influence of Research," by Dean F. Paul Anderson, director of A. S. H. & V. E. Research Laboratory.
Paper: "The A-A Dust Determinator," by Margaret Ingels.
Paper: "Further Data on Infiltration of Air Through Building Openings," by C. C. Schrader.
Paper: "Equivalent Conditions of Temperature, Humidity and Air Movement Determined with Individuals Normally Clothed (Effective Temperatures with Clothing)" by C. P. Yagloglou and W. Edward Miller.
Paper: "Basal Metabolism Before and After Exposure to High Temperatures and Humidities," by Dr. W. J. McConnell and C. P. Yagloglou.
Paper: "Work Tests Conducted in Atmospheres of High Temperatures and Various Humidities, in Still and Moving Air," by Dr. W. J. McConnell and C. P. Yagloglou, assisted by W. Edward Miller and W. B. Fulton.
Paper: "A Progress Report of the Critical Velocity of Steam Flow in Two-Pipe Systems." Work done by Louis Ebin and Gordon H. Eisenhart. Reported by Margaret Ingels.

THURSDAY AFTERNOON, JANUARY 29

Inspection trips.

THURSDAY EVENING, JANUARY 29

Annual dinner and entertainment at Copley-Plaza Hotel.

PROFESSIONAL SESSION, FRIDAY MORNING, JANUARY 30

Paper: "Basing Warm-Air Heating Selections on Climatological Conditions and Heater Performance Curves," by Professor V. S. Day.
Paper: "Some Facts About Enclosed Radiation," by R. V. Frost.
Paper: "A Proposed Method of Comparison for Fan Heating Surfaces," by A. E. Stacey and L. C. Soule.
Paper: "Characteristics of an Air-Tube Heater," by L'Roche G. Bosquet and George A. Foisy.

PROFESSIONAL SESSION, FRIDAY AFTERNOON, JANUARY 30

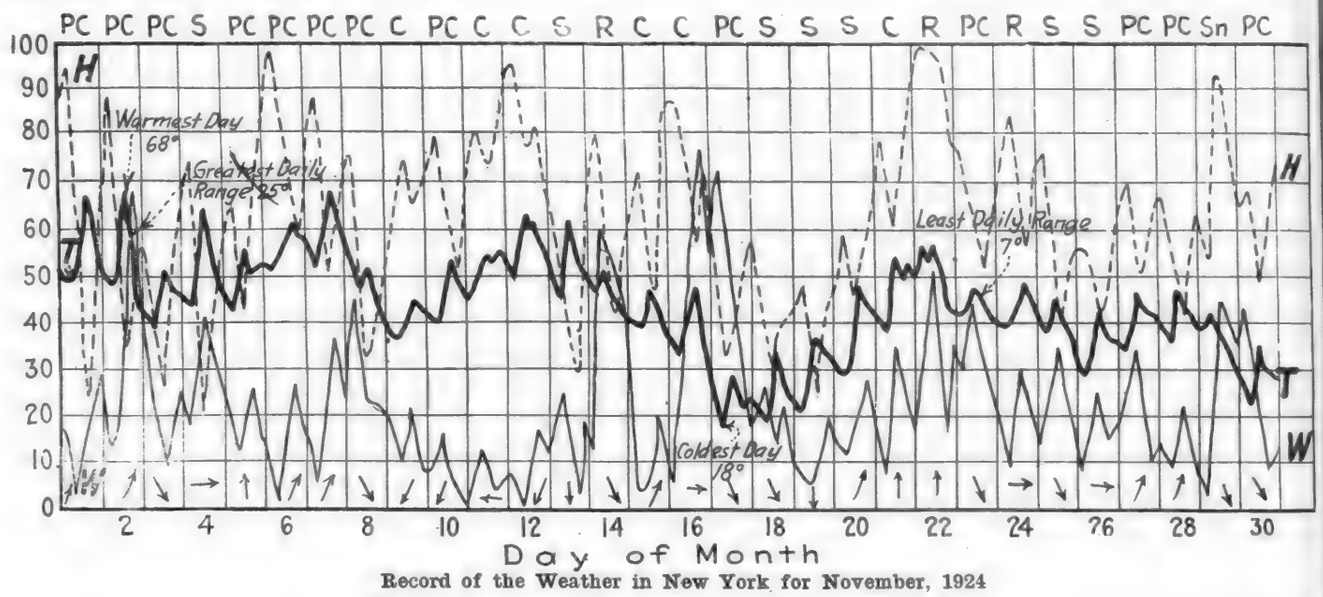
Paper: "Heat Transference and Combustion Tests in Small Domestic Boilers," by H. W. Brooks, N. L. Orr, W. M. Myler, Jr. and C. A. Herbert.
Paper: "Designing and Planning for Home-Heating Economics, with Especial Reference to Anthracite Utilization," by .D. Knickerbacker Boyd.

Under the direction of President William T. Jones, of the Massachusetts Chapter, and General Chairman Alfred Kellogg, of the chapter's general committee, Boston is preparing to welcome the largest gathering of heating and ventilating engineers in the history of the society.

Among the inspection trips planned is one to the plant of the B. F. Sturtevant Company, at Hyde Park, Boston, and one to the plant of the United States Cartridge Company, at Lowell, where the cartridge copper air heater is manufactured.

The Weather For November, 1924

	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, deg. F.	68	76	73	75	77
Date of highest temperature	2	7	7	5	3
Lowest temperature, deg. F.	18	14	14	12	20
Date of lowest temperature	17	17	30	29	29
Greatest daily range, deg. F.	25	27	30	34	35
Date of greatest daily range	2	8	5	7	5
Least daily range, deg. F.	7	7	4	5	5
Date of least daily range	23	24	23	17	14
Mean temp. for month, deg. F.	44.1	44.5	42.8	41.5	47.6
Normal mean temp. for month, deg. F.	44.2	42	43.2	41.2	45.1
Total precipitation, in.	2.04	1.93	1.39	0.86	1.53
Total snowfall, in.	Trace	0.5	1.2	1.0	1.1
Normal precipitation this month in.	3.44	4.1	2.55	2.5	2.88
Total wind movement for month miles	13639	7601	8906	10167	11015
Average wind velocity miles per hour	18.9	10.6	12.4	14.1	15.3
Prevailing direction of wind	N. W.	S. W.	S. W.	W.	S.
Number of clear days	7	11	7	9	15
Number of partly cloudy days	15	10	14	11	8
Number of cloudy days	8	9	16	10	7
Number of days with precipitation	4	5	10	8	7
Number of days with snow	1	1	2	1	1
Snow on ground at end of month, in.	None	0.5	0.7	0.1	None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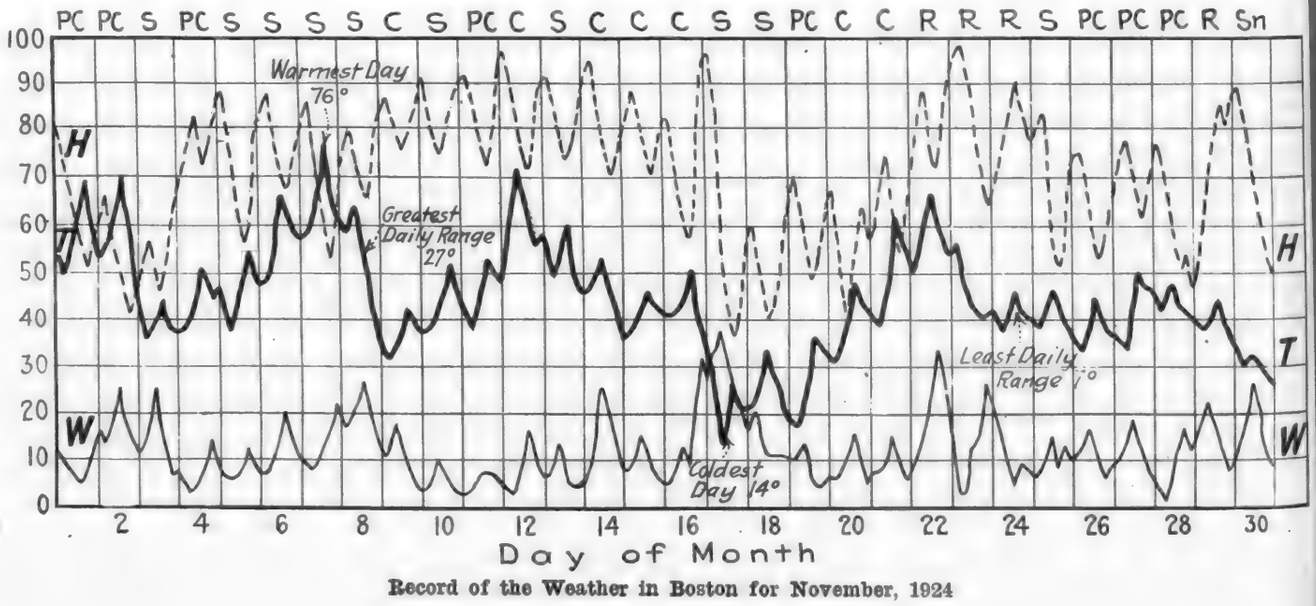
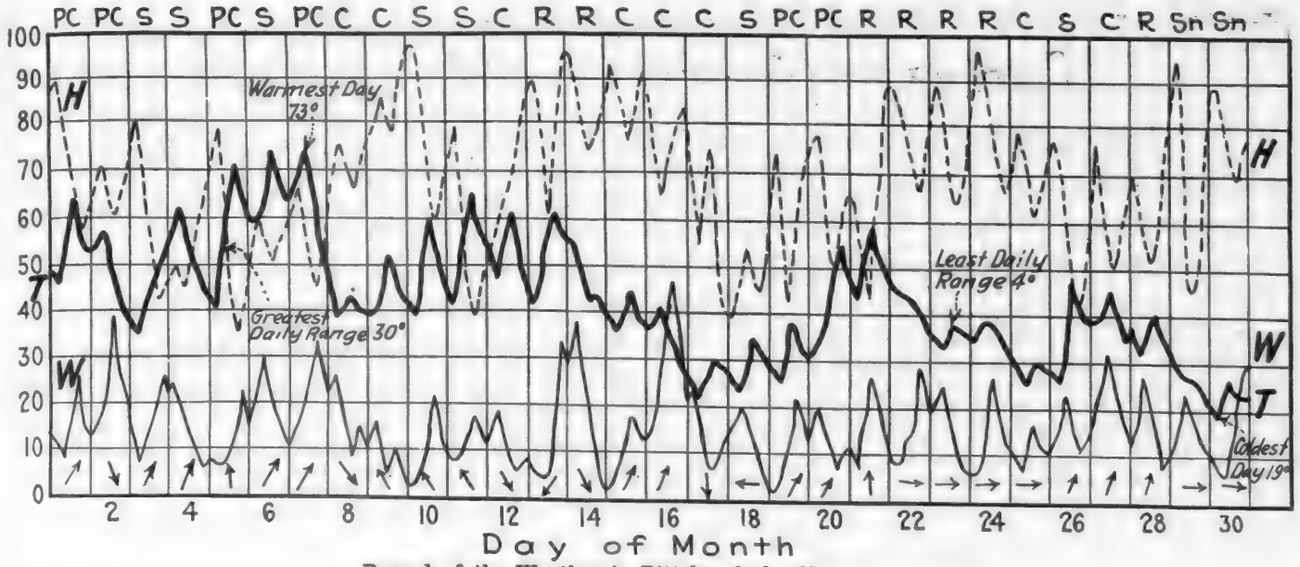
H
Warmest Day 68°
Greatest Daily Range 25°
Least Daily Range 7°
Coldest Day 18°
T
W
Day of Month

Record of the Weather in New York for November, 1924

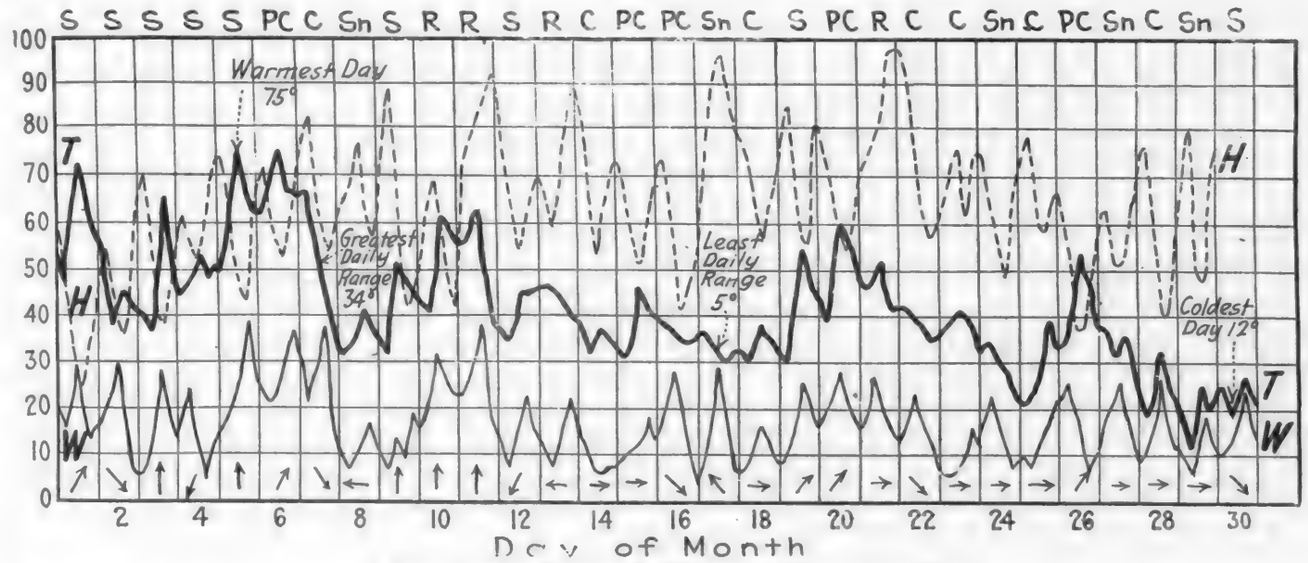
(Hourly Observations of the Relative Humidity Plotted on this Chart)


PC PC S PC S S S S C S PC C S C C C S S PC C C R R R S PC PC PC R Sn
H
Warmest Day 76°
Greatest Daily Range 27°
Least Daily Range 7°
Coldest Day 14°
T
W
Day of Month

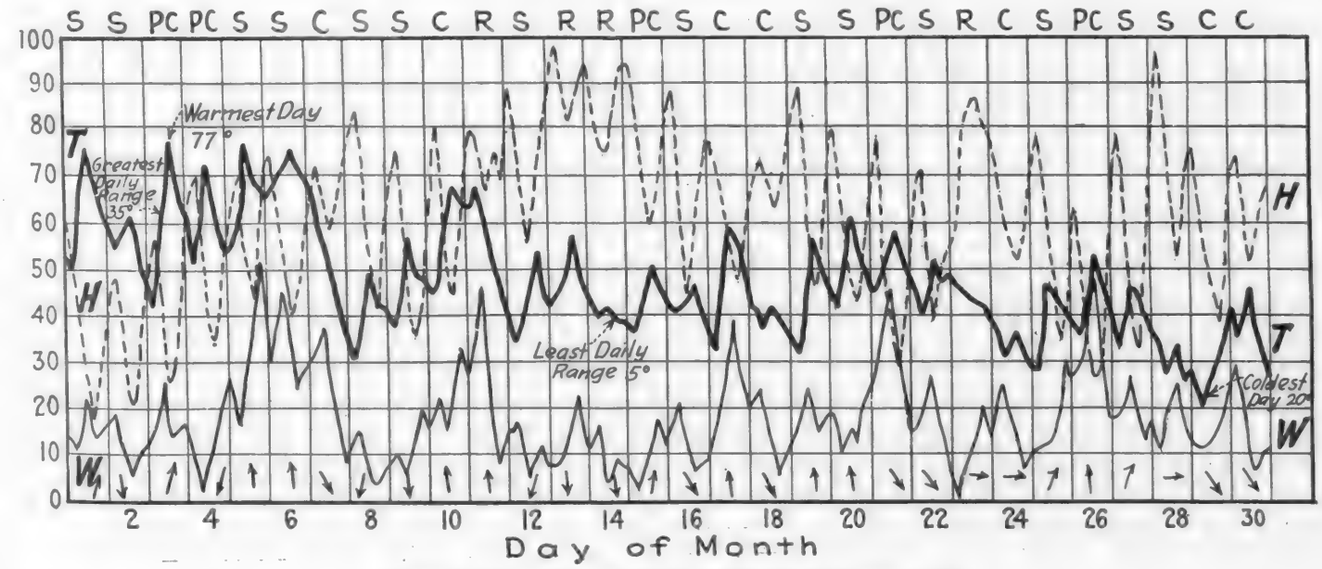
Record of the Weather in Boston for November, 1924


PC PC S S PC S PC C C S S C R R C C C S PC PC R R R R C S C R Sn Sn
Warmest Day 73°
Greatest Daily Range 30°
Least Daily Range 4°
Coldest Day 19°
H
T
W
Day of Month

Record of the Weather in Pittsburgh for November, 1924


S S S S S PC C Sn S R R S R C PC PC Sn C S PC R C C Sn C PC Sn C Sn S
Warmest Day 75°
Greatest Daily Range 34°
Least Daily Range 5°
Coldest Day 12°
H
T
W
Day of Month

Record of the Weather in Chicago for November, 1924


S S PC PC S S C S S C R S R R PC S C C S S PC S R C S PC S S C C
Warmest Day 77°
Greatest Daily Range 35°
Least Daily Range 5°
Coldest Day 20°
H
T
W
Day of Month

Record of the Weather in St. Louis for November, 1924

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F. Light Lines indicate wind in miles per hour
Broken lines indicate humidity in percentage from readings at 8 A. M., 12 M., and 8 P. M. Arrows fly with prevailing directions of wind.
S—Clear, PC—partly cloudy, C—Cloudy, R—rain, Sn—snow.

Correspondence

Extending the Vacuum to the Inside of the Radiator

EDITOR HEATING AND VENTILATING MAGAZINE:

I have heard a lot of talk about the water of condensation in a two-pipe vapor-vacuum system flashing back into steam when it enters the return in which there is a vacuum, after leaving the radiators in which there is a pressure and I am curious to know how such a thing could occur to the extent of being bothersome to the vacuum pump.

To set a concrete problem as I see it:

Assuming 2 lbs. gauge pressure in the radiator and 9.34 lbs. absolute pressure or 10 in. vacuum in the returns, then the water of condensation on leaving the radiator would have a total heat content of 187.10 B.T.U. per pound. On passing into the return under 10 in. of vacuum it need have only a total heat content of 157.91 B.T.U. to remain water. Therefore there will be 29.19 B.T.U. to spare, which could go towards supplying the latent heat necessary for some of the water to flash back into steam.

The amount of latent heat necessary to make 1 lb. of steam under this vacuum is 983.9 B.T.U. Therefore it can be seen that it would be necessary to gather the spare heat units from 33.7 lbs. of water in order to have enough to allow 1 lb. of water to flash back into 1 lb. of steam and as I see it, it would be a pretty hard proposition to gather these spare heat units from so many pounds of water at one time to make 1 lb. of steam.

I should be very much pleased to have your ideas on the matter.

New York INQUIRER

The point brought out by our correspondent is well taken. Theoretically the traps do not pass steam. Practically, however, some few out of many will collect a little rust or scale which will cause the passage of a certain amount of steam at intervals and so may cause at such times the use of some jet water for condensing purposes at the vacuum pump. This is the real reason for the use of jet water—not re-evaporation.

Taking an installation of fair size, say 40,000 sq. ft. of radiating surface, and allowing ¼ lb. of condensate per square foot, we have 10,000 lbs. of condensation which the pump must handle hourly. Radiating effect of the returns (usually estimated as 10%) will be equal to the heat in 1,000 lbs. of this condensate and this will more than offset the heat in the re-evaporated steam to be condensed. Thus for each pound of condensate there will be 0.03 lbs. of re-evaporated steam.

This is computed in a different manner than by the correspondent who starts with the wrong premises but reaches about the same result. For example, the water will not leave the radiator at 219° F. (the temperature at 2 lbs. pressure) but rather at the temperature for which the thermostatic return traps are set, varying from 180° to 210° F. Likewise the return water at the pump will not be at the temperature of 192° (the temperature at 10 in. of vacuum) but instead will be cooled by the radiating effect of the returns to a point somewhat below 180°, which is the maximum temperature at which the pump will handle the return water.

The difference between 210° and 180°, or 30°, is then the excess heat in each pound of water, so that with the latent heat taken for convenience in figuring as 1,000 B.T.U., then in the previous example there is

$$\frac{30 \times 10{,}000}{1000} = 300 \text{ lbs.}$$

of re-evaporated steam hourly to be condensed at the pump, or 5 lbs. per minute, requiring the use of

$$\frac{5 \times 1000}{180-50} = 39 \text{ lbs.}$$

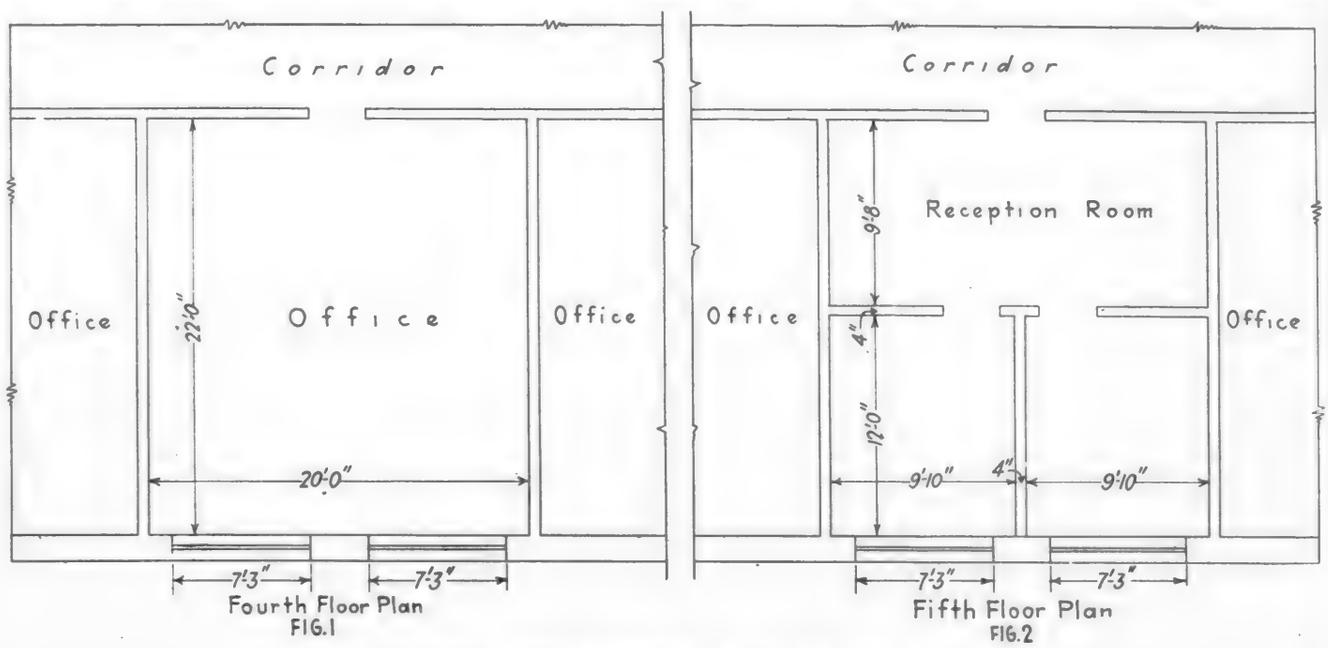
of jet water in the same time. However, as previously pointed out, the radiating effect of the returns of 1000 lbs. is greater than the re-evaporation of 300 lbs., so that the returns will come back to the pump much cooler than the temperature of 180°. Furthermore, even if the pump were required to handle the re-evaporated steam and the necessary jet water, the amount of this would still be but a small percentage of the total water handled by the pump.

Effect of Room Partitions in Figuring Radiation

EDITOR HEATING AND VENTILATING MAGAZINE:

The accompanying blueprint shows two office spaces the same size as those in a typical office building. Fig. 1 is an office on the fourth floor which, you will note, has only one exposure which we will call the north wall. Fig. 2 is part of the fifth floor plan and is intended to represent the office immediately above that of Fig. 1.

On examining the two plans it will



Fourth Floor Plan
FIG. 1

Fifth Floor Plan
FIG. 2

Effect of Room Partitions in Figuring Radiation

be seen that they are identical except that Fig. 2 has interior partitions to make provisions for two small offices whereas Fig. 1 has no partitions at all. The windows are of typical double-hung construction in wood sash, and the brick wall is a 16-in. wall, furred and plastered.

There is an interesting problem here in estimating the radiation for these two offices. In the case of Fig. 1, most engineers would figure the cubic contents of the whole room, but in the case of Fig. 2 they would only figure the cubic contents for the two offices and would not include the reception room. This being the case, would not Fig. 2 indicate that the cubic contents method of estimating the radiation is wrong and should be abandoned by engineers?

Chicago, Ill. A. E. C.

Experience of Burning Buckwheat in a House Heater

EDITOR HEATING AND VENTILATING MAGAZINE:

I am now on my second heating season with buckwheat. As there has been considerable discussion on the possibility of burning buckwheat and the equipment necessary to handle it satisfactorily, perhaps a little first-hand experience in burning it will be of interest. My heater is a Boynton square fire-pot boiler for a water heating system. The grates are the standard wide-opening shaking grates for egg coal and I have not changed them. The only special equipment is a home-made blower with a 1-20 H. P. motor having a speed of 1150 R.P.M. Tests made on the blower show that it takes about the same amount of current as a 40 watt electric lamp.

One of the outfits advocated for burning buckwheat recently described in THE HEATING AND VENTILATING MAGAZINE operated with induced draft. The object of the induced draft was to avoid explosions. There really is no need to have any explosions with forced draft. My blower is connected through a conduit into the ash-pit. During the first week or two there were one or two explosions, but there have not been any since.

I make it a point to put on fresh coal every time the blower is shut off. While the blower is not running the gas burns off to a large extent and the fire is in good condition when it is necessary to blow again. I never put on fresh coal before starting the blower the first thing in the morning. After the fire is going nicely coal may be added without any danger of an explosion.

If for any reason I ever have to cover the entire fire with green coal so that the entire bed is black then I take the slice bar and turn up a red coal and wait a few minutes until the gas has ignited before leaving it. This method of firing has entirely done away with explosions.

In the beginning I lost considerable coal through the grates in removing ashes but soon learned not to try to get out the last bit of ash. It is always that last little extra shake that starts the run. There is always plenty of clinkers to support the fine coal and in case a run does start, it is a simple matter with the slice bar to push a clinker over the hole. But nowadays I never get a run.

WIRE CLOTH OVER GRATE BARS CAUSE OF CLINKERS

Last winter I experimented with some heavy wire cloth laid over the grate bars. This caused large clinkers to form and the only way to get them out was through the fire door with a pair of tongs. Anything over the grates is unnecessary. The special grates that are available for buckwheat would no doubt be an advantage but my experience does not show that they are necessary.

One difficulty I have had with buckwheat has been in keeping a lively enough fire overnight, without the blower running, to keep the house from getting too cold. My chimney draft is very poor and even with stove coal I have difficulty in severe weather in keeping up heat on natural draft. Of course if I had thermostat control to start and stop the blower I could keep up a good temperature over night with the buckwheat but last winter I found that on cold nights the temperature would drop down to 45° and the water in the radiators would go below 80°. In the morning it took several hours blowing and coaling to get it back to a comfortable temperature. This is of course an uneconomical way to operate.

BURNS STOVE COAL AT NIGHT

To get around this condition I am now burning stove coal at night, varying the amount according to the outside temperature. About nine o'clock I remove the ashes. If there is still a good fire left after this operation I add the stove coal immediately. If the fire is pretty low I cover it over with a thin layer of buckwheat and blow until it gets going pretty lively, then add the stove coal. I let the blower run until I have a good water temperature and bank for the night. Banking consists in shutting off the blower and covering over with buckwheat. On mild nights I add considerable buckwheat but on very severe nights just a thin cover. I do not touch the drafts, leaving everything in the same position as while the blower was running. The setting of the drafts must, of course, be established by experience.

I have found that by burning a certain amount of stove coal at night I have completely gotten away from the trouble due to allowing the house to get too cold over night. Now, from a half hour to an hour of blowing in the morning brings the house up to comfortable temperature. After that the blower is started only as needed and nothing but buckwheat added during the day time. An attendent advantage of burning the stove coal is that it does away with all trouble in shaking out ash. No more care is required than with straight stove or egg coal and there is practically no loss. The coal is so thoroughly burned out that I feel sure the loss of unburned coal in the refuse is much less than is usually experienced with the large sizes of coal on natural draft.

After my experience with the blower I am sure I would never want to operate a furnace again without one, regardless of the size of coal burned. With a blower there is no waiting for action when you want it and a fire that is practically out can be quickly brought back to life. One or two of the blowers that are on the market for this purpose are quite noisy and anyone considering an installation should investigate this feature. There is a very small blower that is just the right capacity for the average household which is absolutely quiet. This blower sells for $30. and is the only necessary addition to any furnace to enable one to burn buckwheat if a small amount of stove coal is burned on the night shift. Even the stove coal is not necessary in all cases.

New York HOWARD M. MORGAN.

Ventilating Vagaries

EDITOR HEATING AND VENTILATING MAGAZINE:

On page 80 of your October, 1924 issue, the following item appears:

"A Missouri heating engineer recently sent in this contribution which he says was actually used in a specification for a school-heating installation. It follows without editorial corrections or comments:

There was a bird who had a hunch
That he was an engineer
So he played it strong with results
you see are given here.

"When the weather is sufficiently warm that heat is not required, the blower will be stopped, the windows will be opened and God will ventilate the rooms, (except the toilet rooms)."

The writer is the engineer that wrote the paragraph, which is quoted from the specification. Incidentally the installation is functioning very economically and satisfactorily.

We feel that, in view of the fact that we have admitted ours, the poet should now admit his identity. It is not fitting that such genius should remain unrecognized. Also, we request that you publish this, with the writer's name signed to it, in THE HEATING AND VENTILATING MAGAZINE.

TERRELL CROFT, Directing Engineer,
Terrell Croft Engineering Company.
St. Louis, Mo.

Thatcher Co., New York, is the new name of the Thatcher Furnace Company.

Legal Decisions

Schedule of Electric Heating Rates Increased

The City of Colby asked the Wisconsin Railroad Commission for authority to increase its rates for electric heating and cooking service from 4 cents net per kilowatt hour to 10 cents net per kilowatt hour for the first 75 kilowatt hours, 8 cents net per kilowatt hour for the next 125 kilowatt hours, and 7 cents net per kilowatt hour for over 200 kilowatt hours. The city contended that the existing rate of 4 cents was less than the cost of the energy purchased and much lower than the average rate obtained by power customers. The average cost of energy purchased, on the basis of the kilowatt hours sold, approximated 5.64 cents.

The commission said, however, that cooking and heating rates, as well as power rates, are not based on the average cost. The schedule proposed by the city was identical with the existing power schedule. The commission considered the existing minimum charge for heating and cooking service equitable.

Only six heating customers were connected on December 31, 1923, the average heating load being 1.65 k.w. The largest installation was only 2.05 k.w. Only one of these customers was a residence user. The average consumption per month per heating customer, for the year ended December 31, 1923, was 144 k.w., while power consumers averaged 182 k.w. per month during the same period. Comparisons made based on the detailed consumer data of both heating and power consumers, led the commission to believe the following rate would cover the costs of supplying the service: First 20 kilowatt hours used per month 10 cents net; next 20 kilowatt hours used per month 8 cents net; over 50 kilowatt hours used per month 4 cents net.

The rates proposed by applicant would result in increased revenues from heating consumers of about 123%, while the above rates would increase the revenue from this class of service by 41%.

Patent for Thermostatic Control of Dampers Held Invalid as Previously Dedicated to Public Use

A city contemplated installing ventilating units in one of its school buildings. An architect asked a ventilating company for a heating layout for four classrooms. The inventor of a thermostatic control of dampers for unit ventilation of the kind installed in school rooms and public halls where it is desirable to have the air, in volume and temperature, automatically regulated by the temperature of the room, was associated with this company. After correspondence, the architect called for bids on specifications covering precisely the structure later installed, and which may be called the Waterbury construction.

A general contract for heating was awarded one firm. A subcontract for ventilating units was let to the ventilating company, and a contract for the thermostatic control was let to a third company. Four units were built under the inventor's superintendence and installed and the purchase price of about $2,000 paid. More than two years later May 13, 1920, the inventor applied for a patent which was in due course granted.

In a suit for infringement he was confronted with a Waterbury construction as a prior public use and sale. His reply was that that construction was purely experimental and in consequence did not bar this right to a patent for his invention. The Circuit Court of Appeals, Callahan v. Nesbitt, 1 Fed. (2nd) 75, holds that the step from the Waterbury construction to the device of the patent was too short to involve invention. "If the specifications were Callahan's (the inventor's) conception, he permitted their publication for promiscuous bidding of heating contractors. In other words, he disclosed his invention to the public, and the public—contractors and school commissioners—adopted it, paid for it, and used it. Unless there was something more, this was a dedication of the invention to the public."

The court found nothing said or done by the patentee during the Waterbury construction period which indicated an experimental use, but that to all visible intents and purposes, he or his company made an outright sale. The court said: "Against such a business transaction a secret purpose to test the invention, one presently existing or later arising in the mind of the inventor, cannot prevail. There must be evidence of the need and of the fact of experimentation to bring it within the exception to the law of prior use. We find no such evidence."

Patent No. 1,390,758 was therefore held invalid because of prior use and sale.

Building Contracts, by Classes, 1919-1924

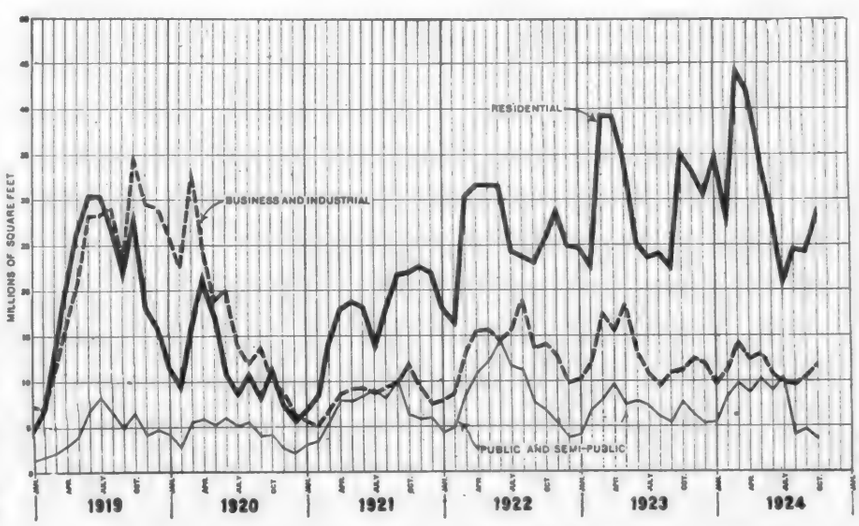
Commerce Reports for December 8, 1924, contains an interesting chart, reproduced herewith, showing the volume of building contracts awarded by classes from 1919 to 1924. As will be seen from the chart, the highest peak yet reached in residential building construction was attained in the Spring of 1924.

Dominion Fuel Board Issues Report of Central Heating

That central and district heating has shown economies, and that such systems may and will be adopted to an increasing extent in Canada, is the conclusion reached by the Dominion Fuel Board in its report of an investigation just issued. The inquiry, which was conducted by F. A. Combe, is in furtherance of the board's policy to encourage the displacement of foreign fuels by those produced in Canada.

One of the essentials to success in district heating, the report points out, is density of load, and for this reason it cannot be successfully adopted in towns of less than 4,000 population, and, if other conditions are not favorable, the minimum population for economic operation is placed at 10,000.

Advantages to be gained in addition to the savings effected by the substitution of low-grade fuels and refuse are elimination of the smoke nuisance, absence of dust and dirt, reduced fire risk,



Volume of Building Contracts Awarded by Classes, 1919–1924

ease of regulation, uniformity of temperature, relief of street traffic from coal and ash traffic, and appreciation in value of property.

The fact is emphasized that very often the cost of service can be lessened by combining the heating plant with a steam electric generating or an industrial plant. Even in the most efficient steam engines and steam turbine generators only 15% of heat in the steam is utilized for power production and, by combining the two plants the other 75% can be utilized for heating. Illustrative of such a combination is the district heating plant at North Battleford, Saskatchewan, where use is made of the exhaust steam from the municipally-owned steam electric generating system.

The report states that the benefits to be derived by consumers are not so much in cost as in greatly increased value of service as respects convenience, cleanliness and relief from handling ashes. A great deal depends, it is pointed out, on the costs of fuel available, but under ordinary conditions it has been generally established that to give the heating company a reasonable return, a rate must be charged for dwellings in excess of the cost of fuel for individual heating.

SCOPE OF INVESTIGATION

In the course of the investigation, examinations were made of 15 district-heating plants in the northern United States, and the two operating in Canada, of which full descriptions are given in the report. Central heating plants such as those used in Toronto and Queen's University, are also described.

Some very interesting facts have been brought out by the inquiry. For example, it is stated that despite its hydro-electric power development, the province of Ontario consumes 60% of the coal requirements of the whole Dominion. Another curious fact is that in spite of the difference in temperature, the coal consumption for heating buildings in Canada is slightly less than in the northern United States. In fact, in the heating of dwellings it is very appreciably less. This, it is pointed out, is due to better building construction and the use of double windows in Canada, to the greater use of hot water radiation, and to the fact that Canadians are used to lower indoor temperatures than are the people of the northern States.—From the *Sanitary Engineer, Plumber and Steam Fitter* (Toronto).

National Trade Extension Bureau

Heating and Plumbing Sales Possibilities in the United States

STATISTICS that picture the potential markets of sales possibilities of an industry are exceptionally valuable to the producer and distributor in these days of scientific management. In the heating and plumbing industries the number of building permits and the amount of contracts awarded, have, for many years, been an important factor in basing future production for manufacturers, and for purchases by distributors.

In publishing figures on this subject, the National Trade Extension Bureau has supplied an index that will go far towards visualizing the sales possibilities of heating and plumbing materials. The figures given are based upon the possible production of a journey man steam fitter or plumber, under normal conditions. They represent the total sales, which includes materials, labor over-head and profits for manufacturers, wholesalers, and contractors.

The statistics show that the estimated number of heating and plumbing shops in the United States, as of July, 1924, is 35,476. The total annual heating and plumbing sales for 1924 is given as $876,773,800. Of these the heating sales amount to $346,816,800 and the plumbing sales to $529,957,000.

As indicated below, these figures are based upon normal installations or employment of journeymen. Therefore, if the employment report of a given territory, as published by the United States Department of Labor, shows an increase or decrease from normal conditions in the building trades, the sales, as indicated in the schedule will likewise be affected.

The schedule which the T. E. B. has drawn up is compiled on the following basis:

In 1920, 5,000 heating and plumbing concerns were surveyed by the Bureau to estimate the average volume of business done in the heating and plumbing industries per year. Reports were obtained from 1,460 heating and plumbing contractors. This survey indicated that the average volume of sales, per heating and plumbing shop, were about $25,000 per year. It also indicated that 40% of these sales was heating and 60% plumbing. This ratio of 40–60 holds good in the majority of states. However, there is a slight variation in some of the southern states, and these variations have been taken into consideration in compiling the figures herewith published.

A further survey conducted in 1920 revealed the fact that there are approximately 30,000 journeyman steam fitters and 73,000 journeyman plumbers in the United States and that they were distributed on an average of 0.8 journeyman steam fitters and 2.1 journeyman plumbers for each shop. The average journeyman steamfitter is responsible for the sale of approximately $47.00 per day, including the cost of material, his own wage, overhead and profit. A journeyman plumber, for approximate sales of $30.00 per day.

From the best information available it appears that the average number of days per year by a journeyman steamfitter or plumber is 230 days. Thus, by multiplying the number of journeyman steamfitters and plumbers in the United States by 239 working days, times $47.00 for the steamfitters and $30.00 for the plumbers, (which represents the average sales), we have the total possible volume of heating and plumbing sales in the United States under normal conditions.

To prove that these figures are fairly accurate, we again return to the survey made of individual heating and plumbing establishments and obtain the total heating and plumbing sales per year. By taking 40% of this result for heating sales and 60% for plumbing sales, we obtain figures that compare with reasonable accuracy with those ascertained from the figures compiled upon the individual efforts of journeyman steamfitters or journeyman plumbers.

Accounting for the Contractor

In order to assist the heating contractors to keep their books intelligently, thereby increasing the efficiency of their business, the National Trade Extension Bureau is now compiling a correspondence course in accounting under the supervision of G. H. Wilson, director. It is expected that this course will be ready January 15, 1925.

T. E. B. through its past successful experience in organizing local classes in bookkeeping (over 90 such classes having been organized in 1924) is thus equipped to help those contractors who can only take advantage of this opportunity in their spare time by mail.

The course will consist of sixteen lessons—four introductory lessons covering "Overhead" or "Fixed Charges," and twelve lessons on bookkeeping proper. Supplementary to these lessons there will be sent to each student from time to time lists of questions bearing on various phases of bookkeeping and business management.

Each lesson will be carefully graded by a competent accountant in the Accounting Service Department of the bureau. All the necessary suggestions and corrections will be given with the return of each lesson.

No previous educational qualifications are required other than that the student be able to read and write and think intelligently.

A cerificate of graduation suitable to be framed will be granted to each student when he has satisfactorily completed all the work of the course.

Every heating contractor, master

plumber of office employee who cannot conveniently join a local class is urged to avail himself of the opportunity afforded by this correspondence course.

Detailed information and prices may be had by addressing the Accounting Service Department of T. E. B., Mercantile Bank Bldg., Evansville, Ind.

Recommended Procedure for Selecting General Contractors and Sub-Contractors

IN THE interest of efficient, economical and workman-like execution of building contracts the Philadelphia Building Congress has issued the following statement of practices to be followed in the selection of general contractors and sub-contractors and urges the adoption of these practices by owners and others in securing estimates and awarding contracts.

1. Do not ask for competitive approximate estimates unless adequately paid for.

2. Furnish complete, clear and accurate plans and specifications when asking for bids.

3. Invite only a limited number of contractors to compete, six generally providing adequate competition.

4. Invite for a given piece of work contractors of substantially equal ability and standing.

5. Invite only contractors to whom you are willing to award the contract.

6. Having invited bids as provided above, award the work to the low bidder, unless other considerations than price are to enter into the award, in which case make this fact perfectly clear in the notice to bidders.

7. Where the time for the completion of the work is important, name a definite time, on which all bids shall be based. Do not invite bidders to name their own time limits as well as their prices.

8. Eliminate as far as possible unit prices, alternate estimates and secondary estimates when asking for bids.

9. Do not award a general contract without determining in advance the sub-contractors to be used on the principal portions of the work.

10. In order to determine sub-contractors in advance follow one of the following methods or a combination: (a) provide that the general bidders shall name the principal sub-contractors they intend to use in their proposals; (b) submit to the general bidders a list of approved contractors for such important sub-contracts; (c) secure principal sub-bids and send a list of designated names and amounts to all general bidders to be incorporated in their bids.

11. Where work is covered by allowances to be adjusted after the general contract has been awarded, reduce such items to the practicable minimum, and do not include under "allowances" sub-contracts of major importance.

12. In selecting bidders for designated bids, or allowances, or for separate contracts, give due consideration to their labor policy, according to the policy adopted for the general contract.

In explanation of the procedure recommended the Congress has some interesting comments to make on current practices in securing estimates and awarding lump-sum contracts for private building operations.

The substances of these comments is given in order with reference to the recommended practices as numbered.

1—APPROXIMATE ESTIMATES

It is desirable on a large or intricate job to have approximate estimates to supplement and check any architect's or engineer's judgment. If the cost of such an estimate is excessive it should be paid for. Of course, the architect or engineer should give the contractor complete information as desired by him. This approximate estimate often saves disputes afterwards as the owner is then informed what to expect.

2—PLANS, SPECIFICATIONS AND FORM OF CONTRACT

In asking for definite bids, complete plans and specifications are, of course, a first essential. Incompleteness, inaccuracy or conflicts in the drawings and specifications increase the cost of preparing the estimates and generally add to the amount of the bid unless, through confusion or error, they result in mistakes that improperly reduce the estimate below a reasonable figure. In either case, the result is unfortunate.

The method of handling a contract differs with the practice of the architect or engineer, or with the special conditions of a particular building operation, being generally one of the following:

1. A general contract, including all trades.

2. A general contract, including all trades except plumbing, electric, elevators and heating.

3. No general contract, each trade being let separately and handled through the office of the architect or engineer.

3—LIMITED NUMBER OF BIDDERS

The cost of estimating is an overhead charge on the industry which has to be paid and it enters into the estimates for all building. It is desirable to reduce it to a minimum, and the first step is to limit the number of bidders invited. Five or six bidders will give the ample competition which the owner desires to assure himself at the reasonableness of the contract price. To invite ten or fifteen merely adds to the cost of estimating without adequate return.

4—SELECTION OF GENERAL BIDDERS

The careful selection of the general contractors to be invited to figure is of the first importance and it must be recognized that all grades of ability are to be found in the list from which one must choose. It is at this point that the owner through his architect or engineer, must determine whether price alone shall control the selection or whether and to what degree quality of performance is desired.

Invite only contractors to whom you are willing to award the contract.

5—PACEMAKERS

Sometimes a group of high-grade contractors is invited, together with one of a lower grade, who is looked upon as a sort of "pace maker." This is an undesirable and unreasonable practice. No one should be invited to bid to whom the owner is unwilling to award the work. When a "pace maker" is invited either his time or that of the other bidders is being wasted.

Having invited bids as provided above, award the work to the low bidder, unless other considerations than price are to enter into the award, in which case make this fact perfectly clear in the notice to bidders.

6—AWARD TO LOW BIDDER UNLESS OTHERWISE SPECIALLY PROVIDED

Having invited a selected group of substantially equal ability, to anyone of whom an award would be satisfactory, then under normal conditions, the contract should be awarded to the low bidder. It should be borne in mind, however, that competition based solely on price tends to reduce the character of service and quality of work estimated on and performed and, therefore, to reduce the standards of performance in the industry.

Where the time for the completion of the work is important, name a definite time, on which all bids shall be based. Do not invite bidders to name their own time limits as well as their prices.

7—TIME LIMITS

Time is often of the essence of the contract and a time limit for the completion of the work involved in the making of estimates. Frequently the bidders are asked to state in their bids the time within which they will complete the work. This is an undesirable practice as it adds a second element of competition and confuses the award. If a time limit, with or without forfeit and bonus, is desired, a reasonable or the necessary time should be stated in the "General Conditions of the Contract Form" and all bidders required to submit their bids on this basis.

8—UNIT PRICES, ALTERNATE ESTIMATES AND SECONDARY ESTIMATES

Eliminate as far as possible unit prices, alternate estimates and second-

ary estimates when asking for bids. Prices for units of work not carefully and accurately defined are frequently not properly applicable to the work as it later appears; and an elaborately-itemized schedule of unit prices that will fit accurately all future contingencies is cumbersome and confusing. Inclusion of alternate estimates in a proposal sheet is an undesirable practice. Where many are required it adds greatly to the expense and the difficulty of preparing a bid and injects an element of confusion to the determination of the successful bidder.

Secondary estimates after the bids are received upon various items, usually small and often reductions, introduce the chance for bidders to revise their original bids by quoting new prices widely at variance with the value of the proposed changes.

9—DETERMINE SUB-CONTRACTORS IN ADVANCE

Do not award a general contract without determining in advance the sub-contractors to be used on the principal portions of the work. In any event, generally a large majority of the work will be done by sub-contractors. Their ability to perform the work is of great importance to the owner. It is not sufficient to rely solely on the reputation of the general contractor, for he cannot produce for the owner work of a better quality than the abilities of his sub-contractors and their mechanics.

10—METHODS OF SELECTING SUB-CONTRACTORS

In order to determine sub-contractors in advance, follow one of the following methods or a combination: (a) provide that the general bidders shall name the principal sub-contractors they intend to use in their proposals, (b) submit to the general bidders a list of approved contractors for such important sub-contracts, (c) secure principal sub-bids and send a list if designated name and amounts to all general bidders to be incorporated in their bids.

The simplest way is to require the general bidders to name for the principal trades the sub-bidders whom they intend to employ. These names can be reviewed and any that are not satisfactory can be changed before an award is made. It should, in such case, be made clear in the notice to bidders that the character of the sub-bidders will be given consideration in making the award.

11—SPECIALTIES AND ALLOWANCES

Where work is covered by allowances to be adjusted after the general contract has been awarded, reduce such items to the practicable minimum and do not include under "Allowances" sub-contracts of major importance.

Some branches of the work are of the nature of specialties on which real competition is not possible, or which involve service by cities, towns, or public service corporations not subject to estimate. In such cases the architect must secure such estimates as he can for the particular work desired,—in some cases only a single bid, perhaps, being obtainable.

12—LABOR POLICY

In selecting bidders for designated bids, or allowances, or for separate contracts, give due consideration to their labor policy according to the policy adopted for the general contract. In a community where there is a general trade agreement in force, it is wise for an owner to determine definitely in advance whether his work shall proceed in accordance with such agreement, using organized labor or ignoring such agreement, using unorganized labor.

Points to Remember in Selecting Vacuum Cleaning Apparatus

By C. H. Whiting

The results to be desired in a vacuum cleaning machine are that it will do its work silently, thoroughly and with a minimum of attention, beyond the frequent emptying of the dust collector. It should run smoothly and with very little vibration, if any. The term "vacuum cleaner" is here used in its broadest sense. In reality the cleaning is not effected by a vacuum, but by air currents set in motion by suction.

As in other types of machinery, first cost is not always the last cost. The machine designed and built to give the best economy and greatest durability must be constructed to eliminate periodical repairs.

One of the enemies of economy and durability—but not the most important as applied to vacuum cleaner design—is friction caused by numerous revolving or moving parts. So it is advisable, other things being equal, to favor the cleaner having the fewest number of parts in motion during the operation of the cleaner.

Vibration is another enemy. It is caused primarily by poor construction, faulty design, insufficient bearing surfaces and the unbalancing of revolving fans. The last condition is really the main cause of vibration and frequent repairs.

When the vacuum cleaner is new it will operate with practically no vibration. The operation of the new machine is governed entirely by the manufacturer's opinion of the value of his or their reputation. But, after the machine has been in daily operation for six months or more, the trouble begins—and if the design is faulty it will reoccur after the repairs have been made. This is quite natural, as the trouble has been only temporarily overcome.

ACCUMULATION OF DUST AND DIRT IN THE FANS

The most important enemy of "economy and durability" is the dirt passing through the fans. In reality the dirt and dust does not pass through the fans. It stays in the fans and causes all the damage. Due to the numerous deflection of the air-currents in its course of travel through the fan stages, each deflection acts as a partial separator and the dirt and dust lodges in the fan casings and on the blades or protruding vanes of each fan. The dirt that does not adhere to the revolving fans is thrown with force, at the next deflection, against the inside of fan casing or housing, where it becomes lodged and gradually builds up to the extent of decreasing the air space area. This condition causes a reduction in efficiency of the machine and the suction or vacuum is reduced appreciably.

It is very hard to picture the result of the damage from a condition of this sort. Your first knowledge of this condition will be a complaint that, "the cleaner has a very weak suction and it takes too long to clean with it." Then you call in the repair man and the machine is taken apart—if it is possible to do so—and thoroughly overhauled and repaired.

Ninety per cent. of the repair work on stationary vacuum cleaners, during the first five years of their life, consists of simply removing the dust and dirt, that has become lodged in the fan and the fan casing or housing.

If the work of overhauling is delayed too long new parts will have to replace wornout ones. The cost of these parts, plus the charge for the work done, must be added to the initial investment.

Pick up the directory of any large city and notice the number of firms who seem to be doing a profitable business in the vacuum cleaner repair field. After making a survey the results showed these firms depended on their prospective repair work for more than 60% of their income.

IMPORTANCE OF SEPARATION OF DUST AND DIRT FROM AIR CURRENTS

The most important feature of a vacuum cleaning system should be complete separation of dust and dirt from the air-currents previous to the air passing through the revolving mechanism. The method of separation is of minor importance when compared to the degree of separation.

There are various methods of separating the dust and dirt from the air currents in use to-day among which the cloth-bag method is still widely favored. It is natural on first thought to think that this method is not practical, due to the possibility of puncturing the bag, but the manufacturers using this method have taken this point into consideration and have taken care in the design to prevent any material large enough to cause a puncture from entering the bag.

The writer is familiar with the fact that there are those who are opposed to the use of cloth as a means of separation, but there is always the alternative possibility to be faced of paying for repair work and, of course, the most durable and economical machine is the one which will eliminate periodical repairs and overhauling.

Everyone experienced in the subject has his doubts as to the durability of any make of stationary cleaner. This has been caused by actual experience with, or reports of, the types of machines in use years ago. A large number of old-type machines are still in daily use. The superiority of the new machines, however, over the "old-timers" is sufficient to convince the owners that the advance made in the various designs is truly remarkable.

Important Data on Heat Transmission of Insulating Materials

Under the title of "Heat Transmission of Insulating Materials," the American Society of Refrigerating Engineers, 35 Warren St., New York, has just issued in book form the formal report of the society's Insulation Committee. The report is a comprehensive document, comprising 114 pages of text, including charts, drawings, tables and other illustrations.

The subject matter has been divided into eleven sections, each of which is the contribution of a competent authority and, with but one exception, each contributor is a member of the committee.

One of the main purposes of the committee was to suggest methods of testing the heat transmission of insulating materials. For this reason the sections covering the plate method and the hot-box methods, respectively, form the hub around which all the other sections revolve. The overall conclusion of the committee is that (1) both methods have merit while each is not without some fault, (2) the plate method is essentially adapted for determining the conductivity from which the transmission may be computed, (3) the box method is essentially adapted for determining the transmission from which the conductivity may be computed, (4) the plate method lends itself to the maximum evaluation of error.

Following the introduction, the second section deals with the principles of heat transfer, the third section with definitions, nomenclature and symbols; the fourth with surface transfer of heat, and the fifth with the measurement of temperature. Those who have not already a clear mental picture of the mechanism of heat transfer, a correct understanding of heat transfer nomenclature, a full appreciation of the significance of surface effects and a familiarity with the technique of temperature measurement are given this information in the sections named.

The book is intended and arranged to serve as a desk reference for the practising engineer whose problems require the preparation of new insulation design or the checking of submitted or existing design. For this reason there is provided a section on "The Economic Value of Insulation," another which summarizes in tabulated form the conductivity test values of insulating materials and their significant properties, and another which illustrates the method of computation of typical problems. The section on "The Measurement of Temperature," it is interesting to note, bears the authorship of P. Nicholls, of Pittsburgh, until recently connected with the Research Laboratory staff of the American Society of Heating and Ventilating Engineers.

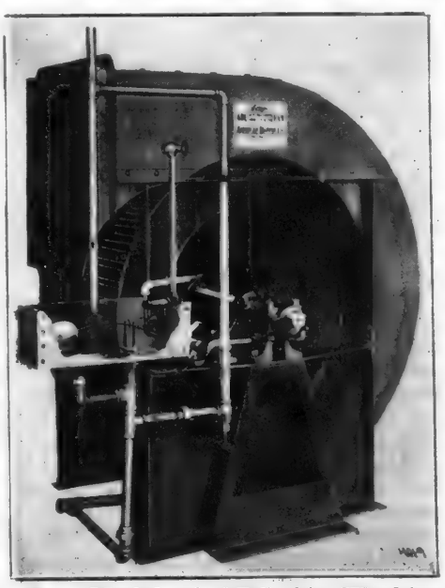
The manual concludes with a remarkably full bibliography of the subject including a brief digest of most of the references. Size 8½ x 11 in. Pp. 114. Price, $2.00.

New Apparatus and Appliances

New Type of "ABC" Air Washing and Cooling Fan

In line with the growing use of smaller units in heating and ventilating work, renewed interest is reported by the American Blower Co., Detroit, Mich., in its "ABC" air washing and cooling fan. As pointed out by W. A. Rowe, chief engineer of the company, in discussing these units, the most serious problem manufacturers of water-type air washers have had to contend with has been the lack of interest on the part of the operating engineers or janitors in the building so equipped in taking adequate care in the upkeep of the apparatus under their direction. The "ABC" air washing and cooling fan was developed to offer a simple and effective mechanical means of washing, cooling, humidifying and delivering a large volume of air at a low operating and initial cost with a machine operating a minimum of space and which, because of its self-cleaning characteristics, requires a minimum of attention on the part of the operator.

As will be seen from the accompanying illustration, this unit combines in one machine the functions of a supply fan and an air washer and humidifier. It is possible to install one of these machines in a space where ordinarily there would be no room available for a spray-type of washer. This is frequently the case in old buildings where ventilating systems are being installed.



New Model of ABC Air Washing and Cooling Fan

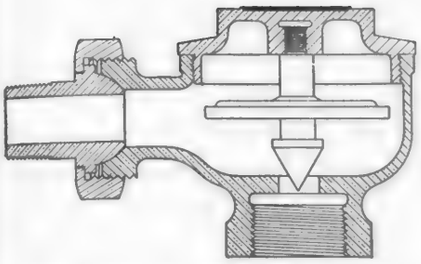
A multiblade fan wheel revolving in a housing is provided with a large amount of screen filter surface, arranged in layers concentrically inside the blades. This surface is kept wet by means of sprays in the inlet of the fan. The water is prevented from passing through the wheel by means of gutters, or eliminators, at the periphery of each blade. These gutters are sloped to guide entrained water to the inlet side of the wheel where it is collected in a concentric V-shaped ring. A stationary nozzle, projecting into this V-shaped collecting ring, picks up the water and causes it to flow back through piping to the spray heads again, thus giving the system a recirculation of water. An ingenious arrangement of overflow piping, together with provision for make-up water from the house service line, provides for the wasting of a small amount of water continuously, which amount is regulated automatically by a ball-float arrangement.

The air in passing over the wet surfaces, it is stated, absorbs sufficient moisture to reduce its temperature at least 50% of the entering wet-bulb depression.

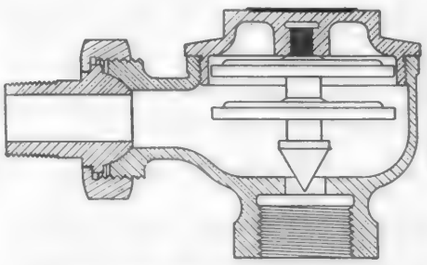
New Thermoflex Line of Steam Specialties

Under the trade name of Thermoflex, the W. D. Cashin Co., 35 Hartford St., Boston, Mass., has recently placed on the market a complete line of vapor and vacuum heating specialties. This line, it is stated, is the result of twenty-years' experience on the part of the company's engineers in the design and manufacture of this kind of specialties. The Thermoflex line consists of thermostatic return traps, graduated modulation valves, vent traps, blast traps, boiler feeders and alternator return traps.

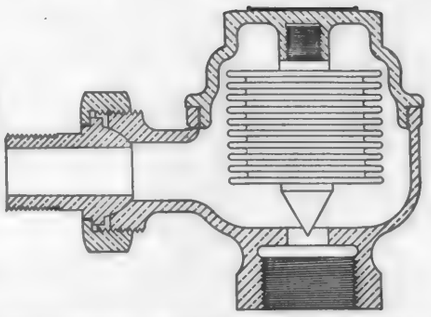
The Thermoflex return traps are made in three styles, single-diaphragm, two diaphragm and bellows. The thermostatic element used in the single and two-diaphragm type is unique in that it has no soldered joint in the center, thus eliminating any possible weakness at this point; the diaphragm



No. 1 trap with single thermostatic diaphragm



No. 2 trap with two diaphragms



No. 3 radiator and drip trap with Thermoflex bellows

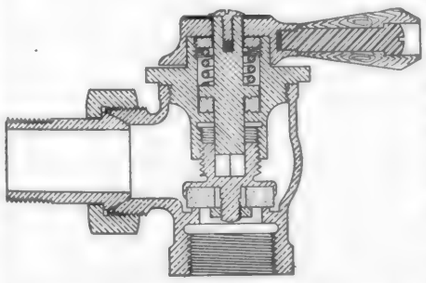
Cashin Thermoflex Return Traps and Radiator and Drip Trap

is one continuous piece of metal from edge to edge.

The two-diaphragm trap is made up of two separate and complete diaphragms, either of which is designed to have sufficient power to close the valve should the other become inoperative. The No. 3 Thermoflex bellows-type trap contains a ten-fold seamless thermostatic bellows with solid bottom, and has an exclusive feature in the form of an internal guide which is designed to maintain the diaphragm in a straight line when expanding and contracting. The ½-in. thermostatic return traps are tapped ¾-in. outlet.

The Thermoflex packless modulation valve is designed so that full opening may be obtained with one-half turn of the lever. The compression spring is in a separate chamber away from the steam, which increases its length of life and elasticity.

The Thermoflex blast trap is a combination float and thermostatic trap, the thermostatic element being the Thermoflex bellows as already described. The Thermoflex alternator, for returning condensate to boiler, is designed so that all working parts are attached to the head inside of the trap.

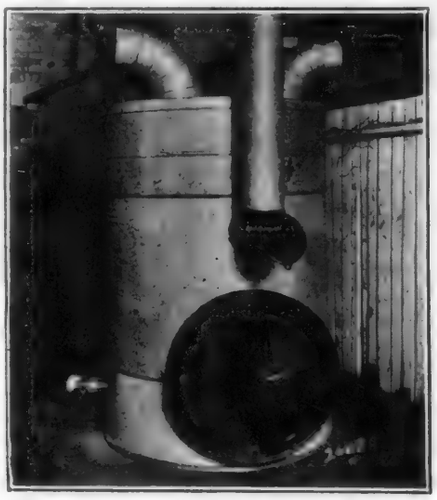


Cashin Thermoflex Inlet Valve

The Thermoflex vent trap is notably simple in construction and design. It contains a seamless copper float to prevent the escape of water in the event of its gathering in the return lines. A featherweight check is used to prevent the return of air after it is exhausted, and thus to maintain a vacuum on the heating system. The Thermoflex boiler feeder has been designed principally to safeguard cast-iron boilers against low water danger, and to act as a positive safety device without flooding.

New Furnace Unit Heaters

A direct-fired furnace unit heater, intended to be of particular value to the small shop, the garage, warehouse, store-room or rural school where steam is not available, is being marketed by



Direct-Fired Furnace Unit Heater

the Buffalo Forge Co., Buffalo, N. Y. This unit is complete in itself and may be installed and made ready to operate in a few hours' time. No connections of any kind are required other than those to the lighting circuit for the motor; no steam or drip connections are needed; no freezing can take place; no skilled engineer need be employed for operation and no foundation other than the floor is required.

This heater will burn anthracite or bituminous coal, coke, wood, oil or gas. In ordinary winter weather, when using coal as fuel, it is found necessary to fire only two or three times per day.

The furnace itself is of the standard warm-air type, with a galvanized-steel casing. The warm-air outlets are brought out at the top. A feature of this casing design is a series of baffle plates which is intended to keep the air in intimate contact with the fire-pot and thereby produce a high rate of heat transmission. All parts exposed to the fire are of heavy cast-iron construction. The fan supplied with the heater is of the Buffalo Breezo type, as already described for the company's new steam and water unit heaters. The fan is built for quiet operation, and due to its design and construction, is attached direct to the furnace casing, which effects a saving in the floor space required. When it is desired to distribute the air to other rooms in the building, a duct system of galvanized pipe may be used. In a case of this kind, the centrifugal-type fan may be required, rather than the Breezo fan, depending upon the amount of piping used.

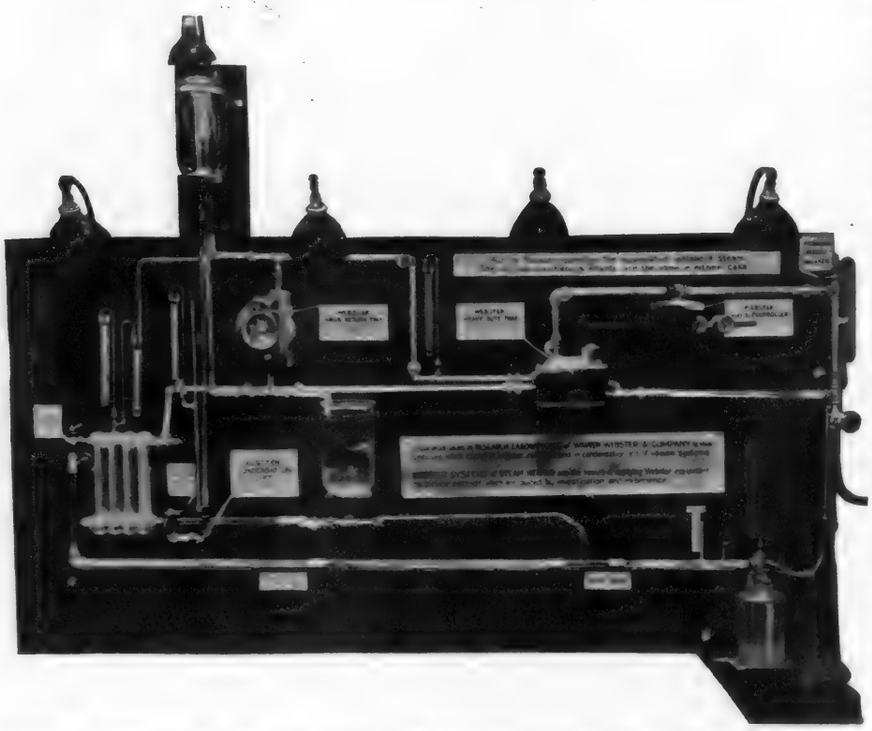
Due to the large capacity of the fan, a rapid air change and consequent uniform temperature may be obtained. Tests have shown that the variation here between the temperature at the ceiling and the floor line is only 4° or 5°. When desired the manufacturer can furnish a coal burner fan for supplying forced draft into the ash-pit. With this installed it is possible to burn buckwheat and other junior sizes of coal.

B.T.U. per hour	A. P. M. at 70° cu. ft.	Wheel Diam. In.	Fire pot in. dia.	Smoke collar in diam.
143,000	1450	18	22	7
200,000	2000	24	26	8

Model Webster Heating System Visualizes Action of Condensation Lifting Device and Other Features

A demonstration of the operation of a heating system of the Webster type which gives a very clear idea of what happens when gurgling or other noises occur in risers and horizontal radiator run-outs and of how condensation is lifted in vacuum heating systems, was the principal feature of the display made by Warren Webster & Co., Camden, N. J., at the recent Power Show in New York. The piping, which was of glass, and the various devices used were mounted on a panel board, the whole outfit being similar to that used in the Webster Research Laboratories, although it was not possible to use steam flowing through the apparatus. The same visual mechanical effects were secured through the use of air.

In the exhibition panel, the glass bottle (1) (Fig. 1) corresponds to the supply riser in a heating system. Glass tube (2) is the horizontal supply pipe and is so arranged that its grade may be varied. Glass tube (3) is the vertical supply connection to the radia-



Model Webster Heating System on Exhibition at New York Power Show

tor (4), the latter being equipped with a Webster modulation valve (5) on its supply inlet and with a Webster Sylphon trap (6) on its outlet for returning condensation and air to the return piping.

Since, with the use of air, there is no condensation forming in the horizontal glass pipe representing the radiator run-out, such as there would be in an actual steam heating system, water is admitted in the tube through a supply pipe (7), the exact quantity being controlled by valve (8).

Air-flow through the run-out piping is produced by an electrically-driven vacuum pump connected to the system at (29). Air is drawn into the system through an orifice (9) in the glass bottle (1), which represents the steam-supply riser. The velocity of air-flow can be varied by changing the differential pressure between the two ends of the pipe (2) by adjustment of the needle valve (26) at the radiator.

With the horizontal run-out tube set at some given grade and with the tube partially filled with water, as it would be in a steam heating system, the velocity of air-flow may be determined by means of the calibrated orifice (9).

The differential pressure of the air and also its velocity can be increased until the critical state is reached as noted by the sweeping of water up and through the pipe (3) and by the failure of the water to flow back to its proper point of drainage (1).

To demonstrate the action of the Webster air lift a constant vacuum is maintained in the upper jar (17). This is accomplished by means of a Webster Hylo controller (10), irrespective of any variations in vacuum which may be produced by the pump.

The vacuum in the jar (17) is greater than that in the radiator (4). This difference in vacuum or pressure-differential between the top of the vertical lift pipe and its base is the means of raising the water (representing condensation returned from a steam heating system) in the lift pipe from the lower to the higher level, and is indicated on the differential mercury gage (30).

For this part of the demonstration the radiator (4) acts as a storage tank, being supplied with water from the open receiver (12) through the glass pipe (16), the exact quantity being controlled by the valve (27). This water (condensation) passes through the Sylphon trap (6) and enters the Webster lift fitting (13).

It has been demonstrated that air must be present with water if condensation is to be effectively lifted. The purpose of the lift test apparatus, as used in the laboratory, is to determine the relation between the quantity of air and the pressure-differential necessary for lifting, which will give best results with the least consumption of power required to produce the differential pressure.

The Webster condensation lift consists of an improved lift fitting (13), a special air admission fitting (14) and a calibrated orifice (18). It is proportioned to admit a definite quantity of air, at any given differential pressure, at the proper point in the vertical lift pipe.

In many present-day installations of vacuum systems of steam heating the pipe work is so nearly perfect that there is not sufficient air inleakage to the return line to provide enough air to play its part in raising condensation up the "lift" to the vacuum pump.

A condition of this sort can be brought about in the experimental panel by closing the air orifice (18). It will be seen that the lift "stalls"; or, under favorable conditions, it may continue to function but requires considerably increased pressure-differential.

It is for such "tight" steam fitting conditions where the condensation has to be elevated from a low level to a higher one, that the Webster condensation lift has been devised. The data necessary for its design has been obtained in the research laboratory with apparatus similar to that shown in the panel.

For re-circulating the water during the demonstration it is desirable to discharge it from the sealed jar (17) at the top of the lift, which is under partial vacuum, to the lower reservoir (12) which is open to the atmosphere. A Webster boiler-return trap (19), the same as installed in Webster Type "R"

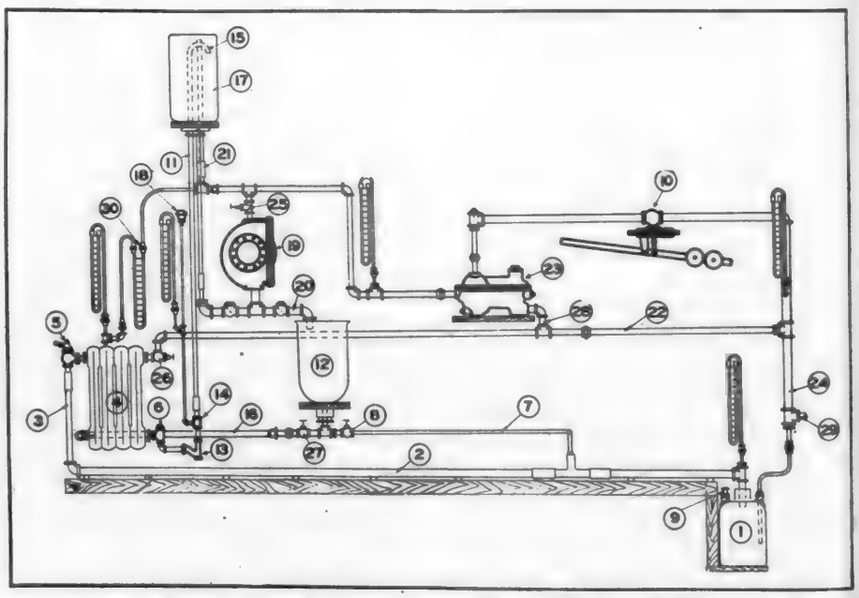


Diagram of Panel Board Containing Model Webster Heating System

modulation systems of steam heating, is used to accomplish this transfer of water.

By means of a valve mechanism operated by a float, this trap is open to the partial vacuum existing in jar (17) while it is filling by gravity from that source, and is closed against that vacuum and opened to the atmosphere while it is discharging by gravity to the lower vessel (12) through the pipe (20).

The valved pipe (25) provides a pressure equalizing connection between the Webster boiler-return trap and the upper jar (17) through the pipe (21).

The Webster heavy-duty trap (23) is used in the apparatus as a separator to catch any water which may be carried over with the air flowing through the pipe (21) from the jar (17), discharging it through the pipe (28). The degree of vacuum at various points in the apparatus is indicated by the several mercury gages connected at these points.

(*Heating and Ventilating Magazine, January*, 1925)

How To Heat Your Home

(This is the fourth of a series of articles giving practical information of fuels and furnaces.)

IV How to Burn Bituminous Coal

By Samuel S. Wyer

Associate in Mineral Technology, U. S. Smithsonian Institution.
(*Science Service*)

IN BURNING soft coal, observe the following rules:

1. Bituminous coal requires more draft and attention than anthracite or coke.

2. Ordinarily, shaking down the ashes will be required only once a day. Then shake only until the glow of the fire is seen in the ash-pit, not until burning coals appear.

3. Pull clinkers out, do not try to work them through the grates.

4. A deep fuel bed is desirable.

5. Stir up the fire and get it hot before adding new fuel.

6. Use some coking method of firing, that is, work the partly burned coal, from which the gas has been driven, to one part of the fire and throw the fresh coal on the remaining portion.

7. Leave visible a bright spot of live coal to ignite the combustible gases coming off the freshly-fired coal.

8. After the fuel is partly burned more heat can be obtained by breaking up the fire bed with a poker if the fuel bed is caked.

9. In banking the fire, the drafts should be open for about half an hour so that the volatile matter on the coal can be driven off before the air supply is greatly reduced.

10. Keep flue surfaces free from soot and cleaning doors tightly closed.

The small-sized coal, like nut, will be easier to handle and more economical than the large lump coal. Uniformity of size is desirable because it permits easier control of fire.

The practice of wetting coal decreases the fuel economy, as heat from the fuel must be used for evaporating the moisture. But with very fine coal, and particularly when the grates are not designed for fine fuel, it may be necessary to moisten the coal in order to reduce the loss of fuel through the grate.

If the entire surface of the fuel bed is covered with a heavy charge, the volatile matter from the coal fired does not ignite for a considerable length of time after firing and passes away as tarry, greenish yellow smoke. Smoke comes primarily from improper burning of bituminous coal. In most residential communities, the trouble is largely from house chimneys. Smoke-prevention appliances, easily adapted to industrial plants, are not generally feasible in the home.

(*Next month*: *How To Burn Coke.*)

New York Power Show

The growth in the art of power generation was vividly shown by the increase in size, from standpoints of attendance and displays, at the recent New York Power Show at the Grand Central Palace, New York, December 1-7. The show was practically 50% larger than last year's and three times the size of the 1922 exposition. The 380 exhibitors, requiring two and one-half floors, amply demonstrated how advanced improved power engineering has become. Progress was shown in practically every line.

Following are some of the concerns which exhibited at the Power Show: Alberger Heater Co., Buffalo; American Blower Co., Detroit; Armstrong Cork & Insulating Co., Pittsburgh; American Schaeffer & Budenberg, Brooklyn; American Steam Gauge & Valve Co., Boston; Armstrong Machine Works, Three Rivers, Mich.; Bailey Meter Co., Cleveland; Ballwood Co., New York; Barnes & Jones, Boston; Bristol Co., Bridgeport; Buffalo Forge Co., Buffalo; Buffalo Steam Pump Co., Buffalo; Bundy Steam Trap Co., Nashua, N. H.; Carling Turbine Blower Co., Worcester; Carrier Air Conditioning Co., Buffalo; A. W. Cash Co., Decatur, Ill.; Cochrane Corporation, Philadelphia; Crane Co., Chicago; Crosby Steam Gauge & Valve Co., Boston; Culm-Burn Equipment Co., New York; Julian d'Este Co., Boston; Joseph Dixon Crucible Co., Jersey City; Elliott Co., Jeannette, Pa.; Farnsworth Co., Norristown, Pa.; Fisher Governor Co., Marshalltown, Ia.; Foster Engineering Co. Newark; Foxboro, Foxboro; Gillis & Geoghegan, New York; Graver Corporation, East Chicago, Ind.; Griscom-Russell Co., New York; Harrison Safety Boiler Works, Philadelphia; Howard Iron Works, Buffalo; Illinois Engineering Co., Chicago; Jenkins Bros., New York; E. Keeler Co., Williamsport, Pa.; LaBour Co., Chicago Heights, Ill.; Mason Regulator Co., Boston; Midwest Air Filters, Inc., New York; Mueller Co., Inc., Decatur, Ill.; Nash Engineering Co., South Norwalk, Conn.; National Tube Co., Pittsburgh; Nitrose Co., Peoria, Ill.; Pratt & Cady Co., Reed Air Filter Co., Inc., Louisville, Ky.; Republic Flow Meters Co., Chicago; Sarco Co., Inc., New York; Smith & Serrell, New York; Swartwout Co., Cleveland; C. J. Tagliabue Mfg. Co., Brooklyn; Taylor Instrument Companies, Rochester, N. Y.; Temperature Control Co., Baltimore; Toledo Pipe Threading Machine Co., Toledo; Uehling Instrument Co., Paterson, N. J.; Walworth Mfg. Co., Boston; Warren Webster Co., Camden, N. J.; Wheeler Condenser & Engineering Co., Carteret, N. J.; L. J. Wing Mfg. Co., New York; Wolff & Munier, Inc., New York; and X Laboratories, New York.

Death of Edward R. Pierce

Edward R. Pierce, at one time in charge of the middle west district for the American Radiator Company and well-known as the author of "A Practical Manual of Steam, Vapor and Hot Water Heating," died at Daytona, Fla. He was 76 years old. Mr. Pierce had been identified with the heating industry for over 40 years. He started his career in Portland, Me., as a manufacturer of wrought-iron pipe radiators and cast-iron heating boilers. He later became connected with the Michigan Radiator and Iron Mfg. Co., of Detroit, Michigan., as manager of the company's New England business.

At the time of the establishment of the American Radiator Company, Mr. Pierce was appointed manager of the New England territory. Shortly thereafter he was transferred to the central district with headquarters in Chicago. His territory then covered Michigan, Indiana, western New York, western Pennsylvania, West Virginia, Ohio, Kentucky and portions of the South. The business grew to such large proportions that a branch was established in Cincinnati to develop the southern States from Ohio to the Gulf and from the Atlantic to the Mississippi. Mr. Pierce was appointed manager of this branch.

He retired from active business in 1909. His book on steam and water heating appeared in 1911. In recent years Mr. Pierce had made his home in Brookline, Mass., and had been acting as representative for Moline Heat of Moline, Ill., in the Boston district. He leaves a widow.

THE STATE OF BUSINESS

Spring Business Promises Well

Prosperous 1925 Market Has Absorbed Reserve Stocks

Especially Prepared for the THE HEATING AND VENTILATING MAGAZINE

By L. W. Alwyn Schmidt

IN STARTING this, the first monthly report for the year 1925, we shall be excused for dwelling, for a few lines only, on the achievements of the Monthly Forecast of the Industrial Markets during the year 1924. We are glad to say that early in the year we pointed to the possibility of a decline and also forecasted correctly the autumnal recovery. These satisfying results of the forecasting system used in the compilation of these reports only repeat the similarily successful survey during the year 1923. We are justly proud of this accomplishment, not only because it proves correct a theory of forecasting but because the very correctness of the forecast will have given a warning to thousands of business men to hold themselves in readiness for the coming changes. Decline and advance, of course, are all in the game, but we play it to better advantage if we guess correctly the hand held by Fate.

The year 1924 has ended with a fair promise for future improvements. For the first time in many months manufacturers enjoy the pleasant feeling of seeing ahead more than a hand-to-mouth business. There is now every indication of a further increase in industrial activity.

The last year has been one of many surprises. It has experienced a violent economic decline in the beginning, followed by a rather sluggish recovery, slow in the coming and very undecided in development. Such a situation may well prove a puzzle to business men and they have met it with unusual caution. As the result, there has been plenty of retrenchment but there were only a few fatalities. Even the boom activities of the stock exchanges following the presidential election caused only a mild interest among outsiders, making the piling up of stock exchange records a matter for professional speculators only.

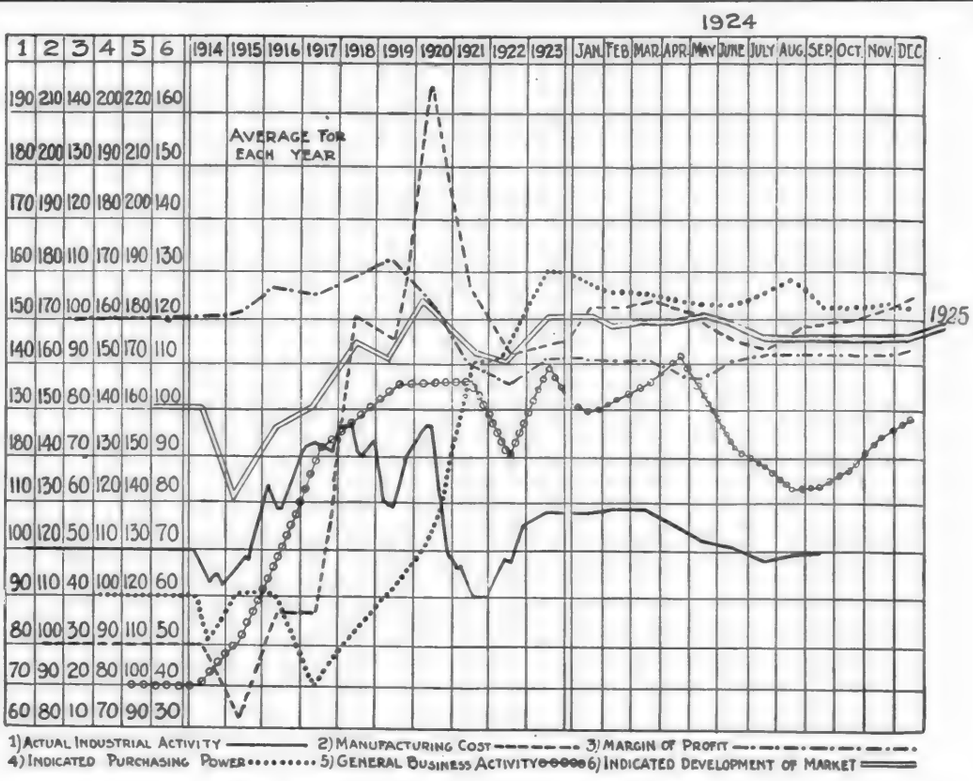
It is extremely difficult to measure comparative market strength. Variations in the purchasing power of the money unit, the productive capacity of labor and other changing factors interfere in obtaining a perfect result. But allowing even for such imperfection in the method of measuring, it seems clearly proven that industrial production during the year 1924 has not kept step with the normal purchasing capacity of the nation.

Only two deductions can be made from this state of affairs:

Either the nation has bought less during the year 1924 than its normal volume of consumption.

Or the nation has lived from its reserve of unsold merchandise.

Both conclusions may require some qualification. There is no doubt of the decline of the actual volume of consumption. This decline, however, cannot be so very extensive if one considers the


1924
1 2 3 4 5 6
1914 1915 1916 1917 1918 1919 1920 1921 1922 1923
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC.
AVERAGE FOR EACH YEAR
1925
1) ACTUAL INDUSTRIAL ACTIVITY
2) MANUFACTURING COST
3) MARGIN OF PROFIT
4) INDICATED PURCHASING POWER
5) GENERAL BUSINESS ACTIVITY
6) INDICATED DEVELOPMENT OF MARKET

Analysis of Business Conditions at End of December

natural increase in the number of consumers, represented by the permanent growth of the population of the United States.

This, in turn, lends weight to the contention that the market has made more use of reserve stocks during the past year than usual. Support is given to this argument by the policy of "clear stocks before ordering" which has been noticed in almost all the retail trading branches of the nation's market. Manufacturing, wholesale and retail trading associations have repeatedly pointed to this tendency among their consumers.

We are meeting here in a somewhat lesser form the same condition which we experienced during the war when the nation's industrial activities were centered upon the production of war material. Now, as then, the reserve stocks of peace merchandise had become depleted, leading to an immense demand for such goods after the conclusion of the armistice. We shall not see an industrial revival of similar strength during the coming year. But it is evident that the nation cannot continue to do business much longer upon the present basis. It will have to turn back soon to a more rational system of merchandising, with shelves well filled for an emergency. This it will do as soon as the retailer finds sufficient encouragement from the consumer.

The consumer's position all through last year has been difficult to define. He has not been a free spender in the so-called consumers' goods, but he has again added largely to his investments by buying life insurance, dwellings and bonds. The savings banks have done much business with him. But he stayed away from the shops. Is it that prices were not attractive enough or has the consumer taken a fright? Whatever the reason is for his attitude, it seems almost impossible that he should continue much longer upon the same path.

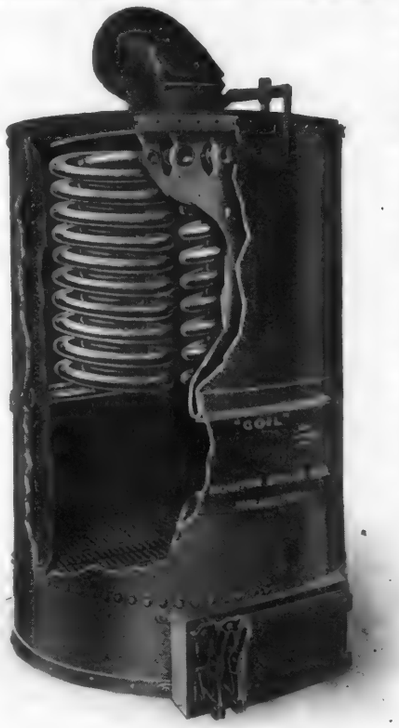
These two factors, the depletion of retail stocks and the inevitable increase of purchases by the consumer are the outstanding features of the present situation. Acting together they must produce, sooner or later, a revival in ordering from the retail centres. But there is still some doubt about the actual date of this revival of trade.

Business men may be inclined to be satisfied already with the improvement we have had so far. But we are entitled to more. We should advance at least 10% ahead of present figures which would mean still only our taking care of the current demand.

Any new buying movement, however, needs money. Not the existence of a money reserve accumulated in the banks, but new money earned by the wage earner. These new earnings will not materialize during the next few weeks. Their advent will be deferred most likely to the early days of Spring. The Spring business in consequence promises to be a good one and it is the eventuality of a revival of trade upon a large basis during March and April which the American business man will have to consider in laying his plans for 1925.

New Trade Publications

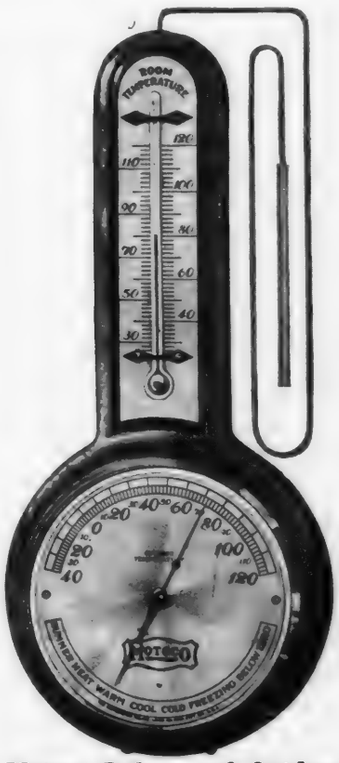
"COIL" STEEL HEATING BOILERS (steel and copper), designed for coal or oil fuel, are an interesting product of the Monitor Boiler Co., 1505 Race St., Philadelphia, illustrated and described in recently-issued circular matter. The point is made in connection with these heaters that they have large combustion chambers and that all the heating surface is exposed to the radiance of the fire. The latter feature is one that bears particularly on the use of oil fuel. The coils being of copper make the boilers quick-heating. A unique arrangement of the coils has been adopted to permit them to take up expansion and contraction without straining the boiler shell. In addition to its use as a heating boiler for either steam or water, the boiler has been found to be especially adapted for furnishing steam to bakeries, dyeing establishments, hotel and restaurant kitchens and other places where a quick and constant supply of steam is required at a low fuel cost. The boiler is also adapted for furnishing hot water for clubs, hotels, apartment buildings. The A. S. M. E. code, it is stated, has been followed in the construction of these boilers. They are made in six sizes for working pressures up to 60 lbs., and in three sizes for working pressures up to 125 lbs. The capacities range from 400 to 2050 gal. per hour.



Construction of "Coil" Steel Heating Boiler, Showing Copper Coils

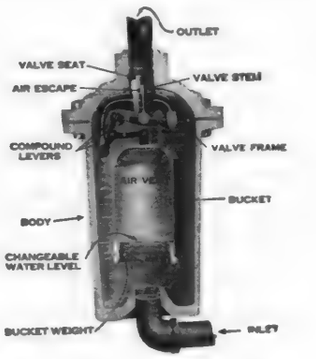
ARCO HOME HEATER, designed especially for the small home, office, garage or any type of small building, is a new product brought out by the American Radiator Co., New York, and described in newly-issued catalogues. The distinctive feature of this heater, apart from its construction and finish which make it suitable for installation in the living room, is its control handle for controlling the dampers. A turn of the control handle, which is placed near the top of the heater, opens the drafts. The control handle may also be set so as to maintain automatically any predetermined temperature. The firebox and body are in one solid, seamless construction, thus eliminating to this extent the possibility of leakage between air and combustion chambers. A lock safe door is also provided to insure tightness. The heater is finished in gray vitreous enamel, while the glow panels in the door are of Pyrex glass.

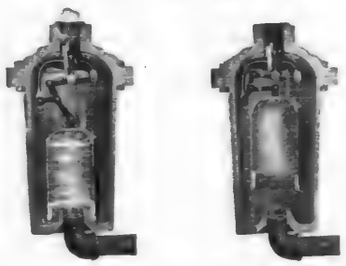
MOTOCO INDOOR AND OUTDOOR THERMOMETER, which may be hung almost anywhere indoors, is an interesting device featured, ni newly-issued circular matter, by the Moto Meter Co., Long Island City, N. Y. An extension tube leads from the thermometer to a point out of doors for indicating the outdoor temperature.



Motoco Indoor and Outdoor Thermometer

ARMSTRONG STEAM TRAPS, in their improved form, are the subject of a new bulletin issued by the Armstrong Machine Works, Three Rivers, Mich. These traps, it is stated, are now built with steel bodies and are tested for pressures up to 3000 lbs. They are designed for use with high-pressure and superheated steam. The valve parts are of non-corrosive chrome steel, machined from bar stocks and then





Trap with bucket down and valve open — Trap with bucket up and valve closed

Construction and Operating Features of Armstrong Steam Trap

heat treated. The trap operates by the rise and fall of an inverted submerged bucket. The valve is opened and closed by the motion of this bucket. The open end of the bucket is directly over the inlet in the bottom of the trap. The outlet of the trap is at the top. Fig. 1 shows the trap with the bucket down and the valve open. Water flowing through the inlet into the trap travels up past the bucket, then out through the valve which is in the top of the trap. Should steam enter, it will collect in the bucket, causing it to float and, in that way, close the valve. This steam will condense and steam or water will enter to take its place. If steam enters, the bucket will continue to float. Should water enter, the bucket loses its buoyancy and sinks, opening the valve and causing discharge to take place. Air entering the trap, it is further explained, is caught in the bucket, the same as steam. This air passes out through a vent in the top of the bucket and collects in the top of the trap, passing out during the discharge. Any steam passing through the vent is condensed by the surrounding cooler water. It will be noted that the trap, with the exception of the bucket, is always full of water. In addition to the usual data regarding the different sizes, the catalogue contains a useful capacity table of Armstrong traps at different pressures, showing how to find the capacity of any size trap at any pressure and the size trap required to handle a given number of pounds of water per hour at a certain pressure. Size 6 x 9 in. Pp. 24.

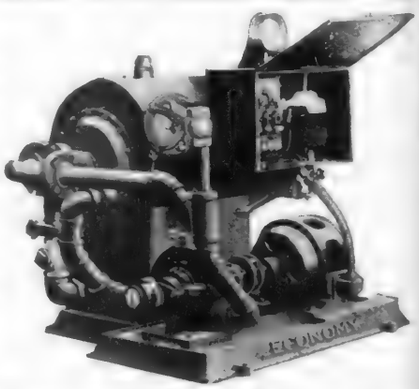
WATER SUPPLY FOR SWIMMING POOLS, with data on design, construction and operation, is discussed in a way calculated particularly to interest engineers, in a bulletin (No. 500) issued by the Graver Corporation, East Chicago, Ind. Under "Modern Design and Construction" the bulletin takes up such details as standard dimensions and economical sizes of filters for pools of different capacities. Details are given of the Graver water filtration equipment, including both vertical and horizontal filters, followed by notes on filter accessory equipment and fittings, including temperature regulation of pool water. Discussing the two generally-used methods of heating the water in swiming pools, (1) by injection of live steam into the water and (2) by live or exhaust steam water heater, an illustration is given of a convenient arrangement for injecting live steam into the pool, direct. The objection, however, to this method, is that the introduction of steam at high pressure directly into the pool causes noise and turbulence. What is described as a far better way is to heat the water by the second method. There is no difference, it is stated in the number of heat units required and consequent consumption of coal. Heating, it is added, after filtering is more preferable as with the low temperature used no precipitation of temporary hardness can occur and loss in temperature is kept down. Details are included, with illustrations, of a number of pools throughout the country. Size 8½ x 11 in. (punched for binding). Pp. 20.

MEASUREMENT OF COAL WITH REPUBLIC FLOW METERS, a bulletin issued by the Republic Flow Meters Co., Chicago, Ill., calls attention to a new product of the company for checking the performance not only of each individual boiler, but also of each attendant. For example, the records of the coal meter

Republic Coal Meter

may be logged at the end of each shift and a chart prepared showing the record of each stoker on each of his shifts. The meter is attached to the driving mechanism of the grate in such a way that the speed of a ratchet wheel is varied in proportion to the grate travel. As the manufacturer points out, if a number of equal volumes of any coal are weighed the variation in weight of the samples is small, so that by multiplying the revolutions of the counting wheel by a suitable constant, an accurate indication of the weight of coal burned may be obtained. The device, it is stated, can be accommodated to any type of chain grate stoker. Some interesting tests are included in the bulletin showing the degree of accuracy of the coal meter. Size 8½ x 11 in. Pp. 12.

ECONOMY CENTRIFUGAL AND VACUUM BOILER-FEED PUMPS are brought to the attention of the trade in a bulletin recently issued by the Economy Pumping Machinery Co., 122-124 North Curtis St., Chicago, Ill. In describing this line the manufacturers emphasize the fact that all Economy vacuum pumps having capacities of over 5000 sq. ft. are equipped with double-suction horizontal split case pumps, which are described as an exclusive feature. This



Economy Boiler-Feed Pump, Illustrating Double-Suction Horizontal Split Case Construction

pump is made in three standard styles, single, standard duplex and special duplex. Each unit consists of a horizontal centrifugal pump taking its suction from a circulating water tank and discharging through two branches, one to the boiler and the other to a jet vacuum producer which is bolted to the head of the circulating water tank. The entire apparatus, it is pointed out, is mounted on a single cast-iron base.

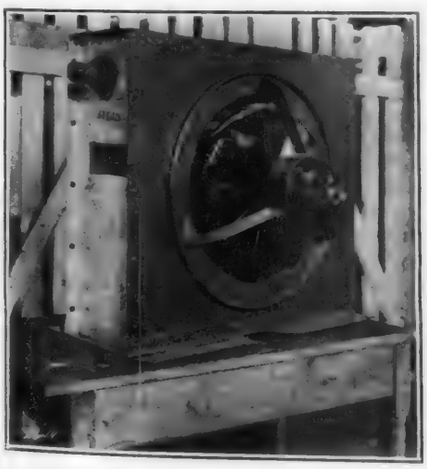
The single unit is recommended for use where a high-grade vacuum pump is required, but where the expenditure must be kept within limits. The duplex units are recommended wherever the cost of installation requires less serious consideration.

The standard duplex is arranged with a single tank mounted between the two centrifugal pumps and motors. Each pump and motor is equipped with its individual vacuum control. In the special duplex both pumps are located on the same side of the tank. The

special duplex is designed for installation in corners, under stairways or in other locations where access can be had to only one side of the apparatus. The usual form of drive is the electric motor, but steam turbines, it is stated, can be successfully applied to the Economy design.

WATER BUT NO CORROSION, treating of the matter of corrosion in water pipes, particularly those carrying hot water, is the subject of a readable manual received from the Elliott Co., Jeannette, Pa. A discussion of the cause of corrosion is accompanied by numerous views taken from photographs of corroded pipes. This is followed by notes on the effect of corrosion on ferrous and non-ferrous pipes. The manual then takes up the company's de-oxygenating apparatus, including the Deactivator (the Speller system), formerly manufactured by the Anti-Corrosion Engineering Company, which renders water inert (non-active) by permitting the dissolved gases to be expended on material that is cheap and readily replaced; and the Deaerator, which actually takes the oxygen and other dissolved gases out of the water. Views are shown of each type, including a number of typical installations, Size 7 ¾ x 10 ½ in. Pp. 24.

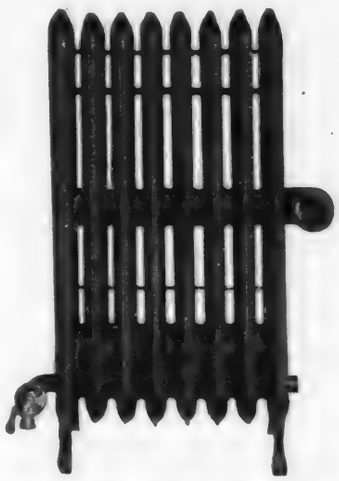
BUFFALO "BREEZO-FAN" HEATERS, of the portable unit type, equipped with Aerofin heater tubes, as featured in a recent blanket circular issued by the Buffalo Forge Co., Buffalo, N. Y., are made in a single 18-in. size. The heater is equipped with a Buffalo "Breezo" fan, having ten curved blades and driven by a totally-enclosed motor. The fan operating at 850 R.P.M. is rated to deliver 1625 cu. ft. of air per minute, and at 1150 R.P.M., 2125 cu. ft.



Buffalo Breezo-Fan Heater

of air per minute. At the 850 R.P.M. speed, the temperature rise is given as from 0° to 93.5°, 32° to 109.5°, 50° to 120°, 55° to 125.5°, 60° to 125.5°, and 65° to 128°. At the 1150 R.P.M. speed, the temperature rise is given as from zero to 86.5°, 32° to 105°, 50° to 115.5°, 55° to 118.5°, 60° to 121.5°, and 65° to 124.5°. The capacity of the heater, based on air entering at zero, is 164,000 and 198,000 B.T.U. per hour, respectively.

HAWKS GAS RADIATORS, including the cast-iron ventilating type, pressed Armco iron ventilating type, and the Hawks ventilating gas radiator suction fan systems, are presented in well-compiled data sheets issued by the manufacturer, the Hugo Mfg. Co., Duluth, Minn. Among the features mentioned in the design of these radiators



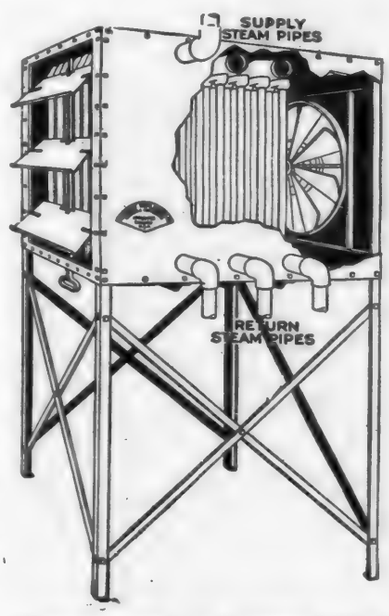
Hawks Ventilating Gas Radiator

is the long path through which the hot gases travel, the large radiating surface heated and the avoidance of many heat transfers. The pressed-iron types are built on the same principle as the cast-iron type and are made to supply a demand for a light-weight unit. The pressed-iron type is finished in baked black enamel, aluminum or browned gold. Instructions are included for installing ventilating suction fan systems in connection with Hawks gas radiators, together with some useful rules for figuring radiation as applied to this type of gas radiators.

REPORT OF TESTS OF AIR WASHER AND REED FILTER INSTALLATION in the office building of a large packing company in Chicago, made at the request of the Reed Air Filter Co., Louisville, Ky., for the construction engineer of the packing company, by E. Vernon Hill Co., of Chicago, has been published in pamphlet form. Diagrams of the equipment are included. The original system was installed with air washers only. Later a bank of steel-wool filters of the Reed type were installed between the reheaters and the fan in an effort to eliminate a certain amount of soot and dirt which came through the washer. The result of the dust determinations showed the efficiency of the air washer to be 81.6% and that of the filters, 95.6%. The resistance through the filters, at a velocity of 377 ft. per minute, was 0.267 in. It is explained in the report that the relatively low efficiency of the air washer is due to the fact that it is required to handle dust containnig a large amount of fine soot. In regard to the efficiency of the filters, which, it is stated, appears low, it is pointed out that it is handling washed air from which 81.6% of the dust has already been removed. The bacteria tests showed the average number of colonies at the intake 228. The average number where the air left the washer was 54 and where the air left the filters, 12.

TYPE EM MOTOR-DRIVEN VARIABLE-SPEED BLOWERS FOR FORCED DRAFT are the subject of a new edition of a bulletin issued by the L. J. Wing Mfg. Co., 352-362 West 13th Street, New York. These units while having a general application for all boilers, have been especially developed for low-pressure heating boilers. As a result, it is stated, they have been used extensively in schools, apartment houses, loft buildings, etc., enabling such plants to effect notable economies by burning low-priced anthracite coal, instead of the domestic sizes. The bulletin includes a number of new illustrations showing how these blowers are installed with heating boilers of various types.

AOTOVENT UNIT HEATERS, made in two types, one a pedestal model for floor installation and the other for ceiling suspension, are announced by the Autovent Fan & Blower Co., 730-38 West Monroe St., Chicago, Ill., in a newly-issued circular. The heating coils used in these units are of the high-pressure type and are designed for use under either high or low pressure. A feature of this arrangement emphasized by the manufacturer is that it makes possible the elimination of pressure-reducing valves. At the same time a high outlet temperature may be obtained. All fittings are connected by hydraulic pressure, no threads being used. Adjustable diffusers, which are



Construction of Autovent Unit Heater

a part of the equipment, make it possible to control the path of the heated air through the coils. Further control, it is stated, can be obtained through valves placed in the steam supply pipes leading to the respective heating coils. In the Autovent fans used with these heaters, a special type of wheel has been designed for delivering the heated air at a high outlet velocity in spite

Autovent Unit Heater Ready for Operation

of the coils placed directly in front of the fan. When a small amount of heat is desired a door at the bottom of the cabinet may be opened, permitting natural air circulation. The heater is made in eight sizes, with capacities ranging from 300 to 10,000 cu. ft. of air per minute.

ROSS PORTABLE DOUBLE-RETURN FIRE-BOX HEATING BOILERS, featuring particularly the smokeless fire-box type, are brought to the attention of the trade in a catalog issued by the Ross Boiler Co., 112 West Adams St., Chicago, Ill., which is the distributor for this boiler. The boilers are made exclusively by the Frost Mfg. Co., Galesburg, Ill. What is described as an important feature in heating-boiler design is the long fire box with a large direct flue and bank of water tubes, presenting an unusual amount of direct heating surface. The large direct flue is intended to permit full expansion of the gases while at their highest temperature in travelling to the front of the boiler. This principle of design, it is stated, brings hotter gases to the bank of fire tubes, thus furthering economical operation when the fire is banked. The A. S. M. E. code is followed in the construction of these boilers. All seams and staybolts are electrically welded. The tube ends are expanded into the heads and care has been taken to make them easily accessible from the outside of the boiler. The grates are of the rocking-finger type with 55% air space. All boilers with the smokeless arch are equipped with dump grates. The smokeless furnace, which is an important feature of the construction, consists mainly of a steel water arch forming part of the boiler. This arch supports the fire brick to complete the smokeless construction. Circulating plates are placed in the steel arch to provide circulation and to prevent the arch from burning out. The Ross boilers, it is stated, have been found highly efficient for oil-burning. They are supplied in thirty sizes for either steam or water, ranging in capacity from 400 to 25,000 sq. ft. steam, and from 650 to 42,000 sq. ft. water. Size 6 x 9 in. Pp. 12.

STANWOOD SMOKELESS BOILERS, for power and heating surface, combining a down-draft furnace with a boiler of the horizontal tubular type for burning volatile coals, is presented in Bulletin No. 810, issued by the Houston, Stanwood & Gamble Co., Cincinnati, O. This boiler is described as having the lowest water level of any steel heating boiler on the market, a feature that will be appreciated by those who have had to contend with shallow cellars or where the depth of the cellar was fixed by the level of the sewer or blowoff. The Stanwood boiler, it is pointed out, has a down-draft furnace, but no steel fire-box. Its furnace resembles the Dutch-oven type inasmuch as its sides are made of fire-brick. Mudlegs, crown-sheet and staybolts are eliminated, obviating any troubles on that score. These boilers conform to the A.S.M.E. code. They are made in ten sizes, varying in capacities from 3200 to 25,000 sq. ft. of steam radiation, and from 5,000 to 40,000 sq. ft. of water radiation. They are built for 15 lbs. pressure or less, although under special order they can be constructed for 150, 175 or 200 lbs. working pressure. The bulletin contains a table giving full details as to specifications; ratings, dimensions and weights.

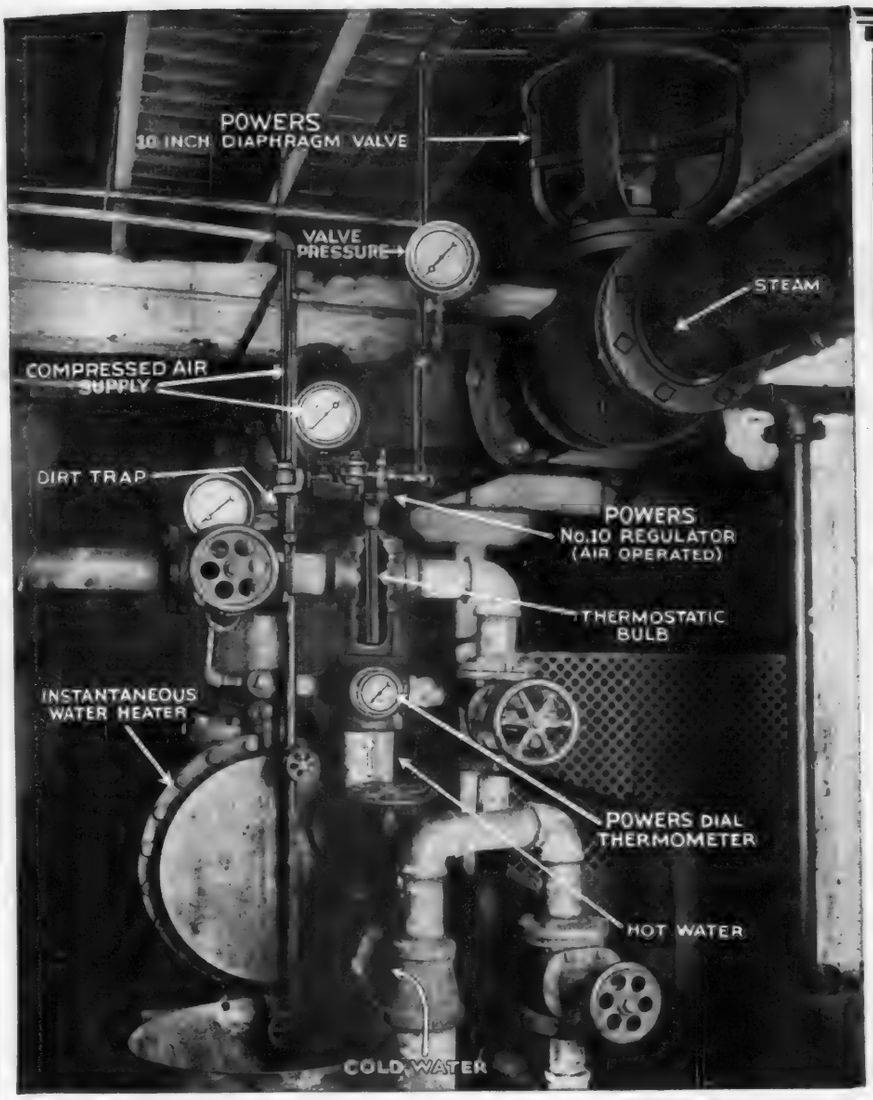
DETRICK ARCHES, described as adaptable to all types of boilers and stokers, industrial furnaces and oil stills, are described in a new eighth edition issued by the M. H. Detrick Co., 140 South Dearborn St., Chicago, Ill. The catalogue is handsomely compiled and includes many detail views showing very clearly the various features of construction of Detrick arches, and the application of the arch to numerous types of boilers. One of the most interesting features of the catalogue is a series of views showing successively the principal steps in the development of the Detrick arch as applied to traveling and chain grate settings, both in the burning of anthracite and bituminous coal. Size 8½ x 11 in. Pp. 50.

HIGGIN ALL-METAL WEATHER STRIP EQUIPMENT and its characteristic features are brought out very clearly in a catalog issued by The Higgin Mfg. Co., Newport, Ky., devoted to "The Reasons for the Higgin Metal Insert Strip." The complete equipment for regular sliding windows consists of two strips, one usually made of zinc, which is attached to the window frame, with a tongue or raised portion which forms a track on which the sash slides. The other strip, called the insert, is made of light spring bronze and is inserted in a groove in the sash. The spring flanges of the insert lightly contact with the tongue of the track to effectually seal the aperture. Air-currents are thus prevented from getting in around the tongue of the track strip. To take care of leakage through the space cut out for the sash cord the insert strip is made to contact closely throughout its entire length, thus sealing this space. Included in the catalog is a view of the experimental apparatus used by the company for testing window leakage and a chart giving the amount of air leakage under different pressures by a sash of a 48-in. x 38-in. window with and without metal weather strips. These curves were developed from a test made by George Hornung, which is reported in full in the catalog. According to these figures, with the wind blowing 40.45 miles per hour the leakage without strips is 89.87 cu. ft. of air per minute. With the track strip alone the leakage is 12.04 cu. ft. per minute, while with the Higgin track and insert strips the report shows the leakage to be reduced to 4.87 cu. ft. per minute. Size 9 x 6 in. Pp. 12.

A. S. M. E. Annual Meeting

Approximately 2,000 members and guests attended the forty-fifth annual meeting of the American Society of Mechanical Engineers, in New York, December 1–4, 1924. The dinner on the evening of December 3, at the Hotel Astor, was a highly-successful affair, covers being laid for 600. The two principal speakers were Dr. Livingston Farrand, president of Cornell University, and Past-president D. S. Kimball. Dr. Farrands address dealt largely with in the increase in human vitality which had been brought about through the increase in knowledge. Mr. Kimball's address was devoted to the ideals of the society and to the opportunities for engineers to promote the interests of their profession and to make their profession more useful to humanity.

Officers elected for the coming year are: President, Dr. Wiliam F. Durand; vice-president, Professor Robert W. Angus, S. F. Jeter and Thomas L. Wilkinson; treasurer, William H. Wiley; secretary, Calvin W. Rice; managers, John H. Lawrence, Edward A. Muller and Paul Wright.



Powers Temperature Regulator Applied to Water Heater in Big Chicago Packing Plant

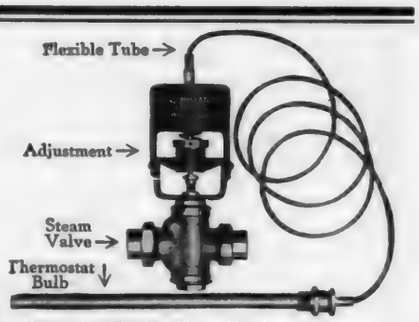
Have you a similar problem?

In applying temperature control to ALL types of water heaters, nowhere else can you find the breadth of experience nor the wide variety of apparatus perfected by the Powers organization.

In studying the problems of your clients, you no doubt find many places where accurate temperature control would save hundreds, perhaps thousands, of dollars a year. Every dollar spent for *hand* control of temperature is money gone forever, same as rent. Experience shows that money invested in Powers control pays handsome dividends.

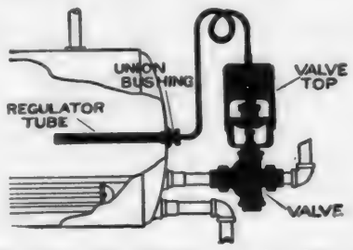
Here is an instance where Powers temperature control is turning *unseen losses* and *profit leaks* into INCREASED EARNINGS:

Large Chicago packers have a reputation for turning all but the squeal of a hog into money. These firms quickly saw the money to be saved with automatic temperature control. In their killing operations, immense amounts of hot water at accurate temperatures are required. Water too hot not only wastes fuel but often spoils the product and slows up production. For these reasons Powers control, as applied to the heater shown above, pays big dividends each year. One Chicago packer has installed three of these controls, one 10 inch, see photograph above, and two 8 inch, and is now ordering four more. (Name upon request.)



Regulator for Tanks, Vats, Kettles, etc.

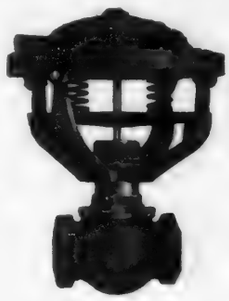
This device automatically controls the temperature of liquids. You simply set it for the temperature you want. It maintains that temperature, and does not vary more than 2° above or below the point for which it is set. You can adjust it for different temperatures if desired. It is easy to install and needs no compressed air or water for its operation. Send for bulletin 129.

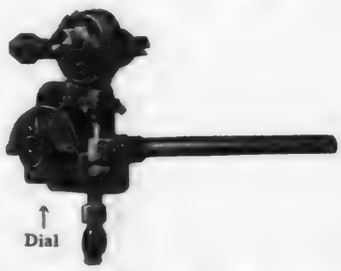


This shows the application of the above regulator to a hot water storage tank. This regulator is adapted to all makes of heater and storage tank systems. Water heating, Water cooling, Steam Cookers, Pasteurizers, Acid baths, Feed water heaters, Glue heaters, etc., may all be made automatic with this regulator.

When used on the hot water service of Hotels, Apartments, Office, School and Shop Buildings, Hospitals, Laundries, Industrial Plants, etc., economy of fuel, labor, and fixtures is secured, which is not otherwise obtainable.

Diaphragm valve at right is shown in the large photograph. It controls the flow of steam to the water heater, and is operated by the regulator shown below.





The regulator shown above is also shown in the large photograph. The tube at the right is the thermostatic bulb, and extends downward, in the photograph, into the hot water line, where its sensitive content reacts to the temperature of the water, thereby controlling the diaphragm valve.

THE POWERS REGULATOR COMPANY

34 years of specialization in temperature control

2718 Greenview Avenue, Chicago

Atlanta, Baltimore, Boston, Buffalo, Butte, Mont., Charlotte, N. C., Cincinnati, Cleveland, Denver, Des Moines, Detroit, El Paso, Houston, Indianapolis, Kansas City, Los Angeles, Milwaukee, Minneapolis, Nashville, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Rochester, St. Louis, Salt Lake City, San Francisco, Seattle

CANADIAN OFFICES

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(2496A)

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

RADIATOR RATINGS

One-Inch Pipe Coil, Concealed, Two Top Registers

1" PIPE COIL — CONCEALED RATING — TWO TOP REGISTERS — STEAM 215° F.

ACTUAL SURFACE is the area of pipe surface per foot length of the coil selected
EQUIVALENT SURFACE is the equivalent number of standard sq. ft. of radiation at 250 B.t.u. per sq. ft.

PIPES HIGH	PIPES WIDE / INCHES HIGH	INCHES WIDE	2		3		4		5		6		7		8		9	
			4"		6½"		9"		11½"		14"		16½"		19"		21½"	
			Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface
6	13 3/8"		4.1	5.1	6.2	7.0	8.3	8.7	10.4	10.4	12.5	12.0	14.5	13.3	16.6	14.9	18.8	16.1
7	15 3/4"		4.9	5.8	7.3	7.9	9.7	9.8	12.1	11.7	14.5	13.4	17.0	15.0	19.4	16.2	21.8	18.4
8	18 1/8"		5.5	6.5	8.3	8.8	11.1	10.9	13.8	13.0	16.6	15.0	19.4	16.7	22.2	18.8	25.0	20.5
9	20 1/2"		6.2	7.1	9.4	9.7	12.5	12.0	15.6	14.2	18.8	16.6	21.8	18.4	25.0	20.6	28.0	22.4
10	22 7/8"		6.9	7.8	10.4	10.5	13.8	13.0	17.3	15.5	20.8	17.9	24.2	20.0	27.6	22.5	31.2	24.4
11	25 1/4"		7.6	8.4	11.4	11.3	15.2	14.0	19.1	16.8	22.8	19.2	26.6	21.7	30.4	24.1	34.3	26.4
12	27 5/8"		8.3	9.0	12.5	12.2	16.6	15.0	20.8	18.0	24.8	20.7	29.0	23.3	33.2	25.8	37.4	28.2
13	30"		9.0	9.6	13.5	12.9	18.0	16.0	22.5	19.1	26.9	21.9	31.5	24.7	36.0	27.4	40.5	30.1
14	32 3/8"		9.7	10.7	14.5	13.7	19.4	17.0	24.2	20.2	29.0	23.1	34.0	26.0	38.8	29.0	43.6	31.9
15	34 1/2"		10.4	10.8	15.6	14.5	20.8	18.0	26.0	21.3	31.0	24.5	36.4	27.5	41.5	30.6	46.7	33.7
16	37 1/8"		11.1	11.4	16.6	15.3	22.2	19.0	27.6	22.4	33.1	25.8	38.8	29.0	43.3	32.2	49.8	35.4
17	39 1/2"		11.7	11.9	17.6	16.0	23.4	19.9	29.4	23.5	35.2	27.1	41.2	30.5	47.1	33.8	52.9	37.1
18	41 7/8"		12.5	12.4	18.6	16.7	25.0	20.8	31.2	24.7	37.3	28.4	43.6	32.0	49.8	35.4	56.0	38.9
19	44 1/4"		13.2	12.9	19.7	17.3	26.2	21.7	32.9	25.7	39.3	29.7	46.0	33.2	52.5	37.0	59.1	40.6
20	46 5/8"		13.8	13.6	20.8	18.0	27.6	22.5	34.6	26.8	41.4	30.9	48.5	34.4	55.3	38.6	62.2	42.1

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Radiator Ratings—1-in. Pipe Coil, Concealed, Two Top Registers — No. 14-BB

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

RADIATOR RATINGS

1¼-Inch Pipe Coil, Concealed, Two Top Registers

1¼" PIPE COIL—CONCEALED RATING—STEAM 215° F. TWO TOP REGISTERS

ACTUAL SURFACE is the area of pipe surface per foot length of the coil selected

EQUIVALENT SURFACE is the equivalent number of standard sq. ft. of radiation at 250 b.t.u. per sq. ft.

PIPES HIGH	PIPES WIDE / INCHES HIGH	2		3		4		5		6		7		8	
	INCHES WIDE	4½"		7½"		10½"		13½"		16½"		19½"		22½"	
		Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface
4	10½"	3.5	4.4	5.7	6.0	6.9	7.4	8.7	8.8	10.4	10.0	12.2	11.3	13.9	12.5
5	13½"	4.3	5.3	6.5	7.0	8.7	8.8	10.9	10.5	13.0	12.0	15.2	13.4	17.4	15.0
6	16½"	5.2	6.0	7.8	8.2	10.4	10.1	13.0	12.1	15.6	13.9	18.2	15.5	20.8	17.1
7	19½"	6.1	6.9	9.1	9.2	12.2	11.4	15.2	13.6	18.2	15.6	21.3	17.5	24.4	19.4
8	22½"	6.9	7.7	10.4	10.2	13.9	12.8	17.4	15.1	20.8	17.2	24.4	19.4	27.8	21.5
9	25½"	7.8	8.4	11.7	11.4	15.6	13.9	19.5	16.5	23.4	18.9	27.4	21.2	31.2	23.4
10	28½"	8.7	9.2	13.0	12.2	17.4	15.1	21.7	17.9	26.0	20.5	30.4	23.0	34.8	25.5
11	31½"	9.6	9.9	14.3	13.2	19.1	16.3	23.9	19.4	28.6	22.1	33.4	24.7	38.2	27.6
12	34½"	10.4	10.5	15.6	14.1	20.8	17.4	26.0	20.6	31.2	23.7	36.4	26.7	41.6	29.5
13	37½"	11.3	11.3	16.9	15.0	22.6	18.8	28.2	22.1	33.8	25.3	39.5	28.4	45.2	31.7
14	40½"	12.2	12.0	18.2	15.9	24.3	19.8	30.4	23.7	36.4	26.9	42.6	30.1	48.6	33.5
15	43½"	13.0	12.6	19.5	16.8	26.0	23.7	32.6	25.0	39.0	28.4	45.6	31.8	52.2	35.4
16	46½"	13.9	13.3	20.8	17.8	27.8	21.8	34.7	26.4	41.6	29.8	48.6	33.4	55.6	37.3

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Radiator Ratings—1¼-in. Pipe Coil, Concealed, Two Top Registers | No. 14-CC

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THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

RADIATOR RATINGS

1½-Inch Pipe Coil, Concealed, Two Top Registers

1½" PIPE COIL - CONCEALED RATING - STEAM 215°F. TWO TOP REGISTERS

ACTUAL SURFACE is the area of pipe surface per foot length of the coil selected.
EQUIVALENT SURFACE is the equivalent number of standard sq. ft. of radiation at 250 B.t.u. per sq. ft.

PIPES HIGH	PIPES WIDE / INCHES WIDE / INCHES HIGH	2		3		4		5		6		7	
		5½"		9"		12½"		16"		19½"		23"	
		Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface
4	12½"	3.9	4.7	5.9	6.2	7.9	7.7	9.9	9.3	11.9	10.7	13.8	11.9
5	16"	4.9	5.5	7.4	7.5	9.9	9.4	12.3	11.0	14.8	12.8	17.3	14.3
6	19½"	5.9	6.4	8.9	8.7	11.9	10.8	14.8	12.7	17.8	14.6	20.8	16.5
7	23"	6.9	7.2	10.4	9.8	13.8	12.1	17.3	14.4	20.8	16.5	24.2	18.6
8	26½"	7.9	8.1	11.9	10.9	15.8	13.5	19.8	16.0	23.7	18.4	27.6	20.7
9	30"	8.9	8.8	13.3	11.9	17.8	14.8	22.2	17.5	26.7	20.1	31.1	22.8
10	33½"	9.9	9.7	14.8	12.9	19.8	16.1	24.7	19.0	29.6	21.9	34.6	24.7
11	37"	10.9	10.5	16.3	13.9	21.8	17.3	27.2	20.6	32.6	22.6	38.1	26.6
12	40½"	11.8	11.1	17.8	15.0	23.7	18.6	29.6	22.1	35.6	25.3	41.6	28.5
13	44"	12.8	11.9	19.3	16.0	25.7	19.8	32.1	23.5	38.6	27.0	44.9	30.3
14	47½"	13.8	12.6	20.8	17.0	27.7	21.0	34.6	24.7	41.6	28.7	48.4	32.2

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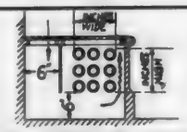
Radiator Ratings—1½-in. Pipe Coil, Concealed, Two Top Registers — No. 14-DD

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

RADIATOR RATINGS

Two-Inch Pipe Coil, Concealed, Two Top Registers



2" PIPE COIL—CONCEALED RATING—TWO TOP REGISTERS—STEAM 215°F.

ACTUAL SURFACE is the area of pipe surface per foot length of the coil selected
EQUIVALENT SURFACE is the equivalent number of standard sq. ft. of radiation at 250 b.t.u. per sq. ft.

PIPES HIGH ↓	PIPES WIDE → / INCHES WIDE → / ↓ INCHES HIGH	2 — 7"		3 — 11½"		4 — 16"		5 — 20½"		6 — 25"		7 — 29½"	
		Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface	Actual Surface	Equivalent Surface
3	11½"	3.7	4.3	5.6	5.7	7.5	7.1	9.3	8.1	11.2	9.6	13.1	10.8
4	16"	5.0	5.7	7.5	7.1	10.0	8.9	12.4	10.5	14.9	12.1	17.4	13.6
5	20½"	6.2	6.3	9.3	8.5	12.4	10.6	15.6	12.3	18.7	14.4	21.8	16.2
6	25"	7.5	7.3	11.2	10.0	14.9	12.2	18.7	14.5	22.4	16.6	26.1	18.6
7	29½"	8.7	8.1	13.1	11.2	17.4	13.9	21.8	16.2	26.1	18.9	30.5	21.2
8	34"	10.0	9.2	14.9	12.3	19.9	15.4	24.9	18.0	29.9	20.9	34.8	23.6
9	38½"	11.2	10.0	16.8	13.5	22.4	16.7	28.0	19.8	33.6	22.9	39.2	26.0
10	43"	12.4	11.1	18.7	14.7	24.9	18.2	31.1	21.6	37.3	24.8	43.5	28.1
11	47½"	13.7	11.9	20.5	15.8	27.4	19.6	34.2	23.3	41.1	26.9	47.9	30.3
12	52"	14.9	12.7	22.4	17.0	29.9	21.1	37.3	25.0	44.8	28.9	52.3	32.6
13	56½"	16.2	13.4	24.3	18.2	32.3	22.6	40.4	26.7	48.5	30.9	56.6	34.6

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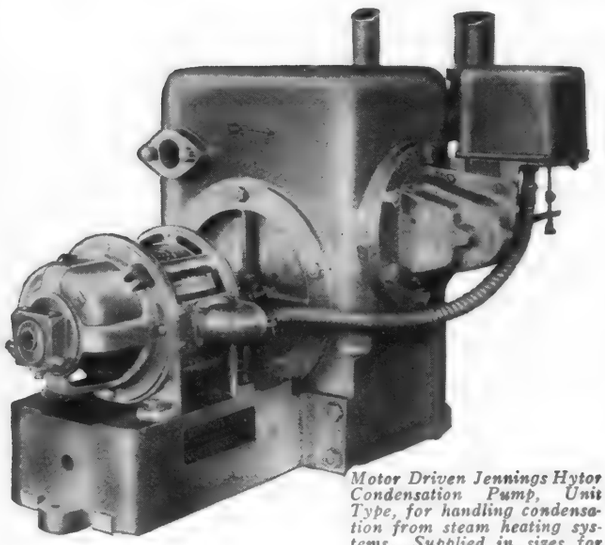
No. 14-EE

Radiator Ratings—2-in. Pipe Coil, Concealed, Two Top Registers

Copies of this Data Sheet, printed separately, 5 cents each.

For improving a poor heating system



Motor Driven Jennings Hytor Condensation Pump, Unit Type, for handling condensation from steam heating systems. Supplied in sizes for equivalent direct radiation up to 16,000 sq. ft.

SYSTEMS having radiation surface at or below the boiler water line cannot depend on gravity alone for returning the condensation to the boiler unless the boiler is set in a sufficiently deep pit.

In installations where condensation is being discharged to the sewer instead of returned to the boiler,—coal is continually wasted. In fact, about 1% is needlessly consumed for each 11° F the condensate is above the temperature of the cold boiler feed water.

Systems such as these can be remarkably improved through the installation of the Jennings Hytor Condensation Pump.

Jennings Condensation Pumps not only result in greater economy of the system as a whole, but they invariably pay for themselves in the costly boiler pit excavations they avoid, in the fuel they save through improved operation, and in greater cleanliness and efficiency of the boiler plant secured.

Bulletin 29 is the one to ask for.

Superior features of the Jennings Condensation Pump

1. *Saving in space*: The rectangular form permits installation in a corner against the wall.
2. *Low return connections*: Distance from center line of gravity returns connection to floor a minimum.
3. *Quiet operation*: Absence of flexible coupling and elimination of separate steel returns tank insure noiseless operation except for slight motor hum.
4. *Impeller*: Bronze, open type, self-cleaning.
5. *Cast iron receiving tank*: Reinforced cast iron tank, tested by hydraulic pressure. Has large settling chamber.
6. *Companion flanges*: Supplied for connection to system. No connections between the pump and the tank are required.
7. *Wiring*: Furnished in armored conduit between motor and switch, connected, ready for use.
8. *Ball float*: Heavy 5 in. diameter, seamless drawn ball float, tested to 100 lbs.
9. *Float switch*: G. E. double-pole float switch, with silver contacts, totally enclosed. Float mechanism can be removed as a unit.
10. *Drip pan*: Base forms drip pan, tapped for drain.
11. *Motor bearings*: Rugged, with liberal oil wells.
14. *Three point support*: Prevents misalignment.

NASH ENGINEERING COMPANY

So. Norwalk Connecticut

Branch Sales Offices in *Atlanta, Boston, Buffalo, Chicago, Cleveland, Dallas, Denver, Detroit, Houston, Indianapolis, Kansas City, Los Angeles, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, St. Louis, Salt Lake City, San Francisco, Seattle and Washington, D. C.* In Canada: *Montreal, Toronto and Vancouver.*

Jennings Hytor

RETURN LINE AND AIR LINE VACUUM PUMPS CONDENSATION AND CIRCULATING PUMPS

Trade and Miscellaneous Notes

Miscellaneous Notes

Seattle, Wash., has adopted an ordinance compelling the heating of apartment houses from 7 A. M. to 10:30 P. M. The temperatures specified by the new ordinance are 60° F. at 7 A.M.; 65° from 7:30 A.M. to 8:30 A.M. and 68° from 8:30 A.M. to 10:30 P.M.

Knoxville, Tenn.—Two ordinances are pending in Knoxville to safeguard the city against fire. One of these is to regulate the storage of oil fuel and the other for handling and storing inflammable liquids.

Central Supply Association will hold its winter meeting in Chicago, February 25-26, at the Hotel Sherman.

University of Chicago has drawn up plans for a continuous line of buildings on the north side of the Midway, from Drexel Avenue to Dorchester Avenue. Included in the group will be a new chapel, a medical building and a library. The estimated cost, which includes increased salaries for members of the faculty, is $17,500,000.

National Exposition of Chemical Industries, which is scheduled for the week of September 28 to October 3 at the Grand Central Palace, New York is planning for a joint meeting of close to twenty technical and commercial associations during the Exposition.

Southern Exposition, it is announced, will now be held May 11-23, at the Grand Central Palace, Ney York. The postponement from January to May was found necessary due to the fact that a number of states could not complete their displays in time.

American Artisan and Hardware Record, of Chicago, has been purchased from the Stern estate by C. W. Stafford and Frank McElmain, who have been associated with other fields of publishing. It is announced that Miss Etta Cohn and A. G. Pederson, who have been conducting the publication during the past four years, will remain as members of the new organization and will continue in active charge.

Eastern Supply Association will hold its regular winter meeting in New York City, February 11, at the Hotel Astor.

Detroit, Mich.—Three hundred heating contractors and master plumbers met in Detroit, November 13, to discuss oil burning and oil burners. The members of the party were the guests of the Nelson Co., jobbers of heating and plumbing supplies. The speakers included Mr. Nelson, William T. Dean, of Milwaukee, and G. H. Schildmiller, of the American Radiator Co., Detroit.

Association of Plumbing and Heating Salesmen of Greater New York, Division No. 1, has been incorporated. The association which has had a rapid growth, meets monthly for dinner at the Lion d'or Restaurant, 61 West 24th Street, New York.

National Warm-Air Heating and Ventilating Association will hold its annual convention in Cleveland, O., April 15-16, 1925.

New York.—Three additional oil burners have been approved by the New York City Board of Standards and Appeals. They are the Dahl oil burner, petitioner, the Bethlehem Ship Building Corporation, Ltd.; the Ray rotary fuel-oil burner, petitioner, Preferred Utilities Co.; and the Ballard domestic oil burner, petitioner, Ballard Oil Equipment Company.

U. S. Civil Service Commission.—An examination for junior engineer will be held throughout the country, January 21, 1925, to fill vacancies in various

ACTIVE SALES OFFICES AND AGENCIES IN ALL PRINCIPAL CITIES

ANNOUNCEMENT!

The Autovent Fan & Blower Company are pleased to announce the addition of Autovent Unit Heaters to their fan and blower line.

These units embody a number of attractive and superior features which are fully described by bulletin 65.

A complete Engineering Data Book is also ready for distribution to heating and ventilating engineers. Your copy will be mailed upon request.

AUTOVENT FAN & BLOWER CO.

730-738 W. MONROE ST. - - CHICAGO

branches of the government service, at an entrance salary of $1,860 a year. Advancement in pay may be made without change in assignment up to $2,400 a year. Examination will be given in the following optional subjects: bridge engineering, civil engineering, highway engineering, mechanical engineering and structural engineering. Information and application blanks are obtainable from the U. S. Civil Service Commission, Washington, D. C., or from the secretary of the board of U. S. Civil Service Examiners at the post office or custom house in any city.

Manufacturers Notes

Kennedy Valve Mfg. Co., Elmira, N. Y., announces the removal of its San Francisco office to new and larger quarters at 448-450 Tenth St., San Francisco.

American Radiator Co., New York, is preparing plans for a $55,000 one-story addition to its Buffalo plant.

Linde Air Products Co., New York, has opened two new district offices one in Salt Lake City, at 210 Dooly Block, in charge of R. L. Strabel, and the other in Seattle, Wash., at 304 Railroad Ave., South, in charge of C. E. Rhein.

Sterling Engineering Co., Milwaukee, Wis., has moved its main offices from 209 Third Street to 1636 Holton Street.

H. Mueller Mfg. Co., Decatur, Ill., announces the inauguration of a new policy whereby the company hereafter will market its goods through the jobber.

Pittsburgh Valve, Foundry & Construction Co., Pittsburgh, Pa., has appointed Harold S. Hall as manager of its sprinkler equipment and factory heating department.

SEE OUR DETAILED DATA IN ASH&VE GUIDE

SEE OUR DETAILED DATA IN ASH&VE GUIDE

SAGINAW LIKES IT—

CENTRAL JUNIOR HIGH SCHOOL
EAST SIDE, SAGINAW, MICHIGAN
Cowles and Mutcheller, Saginaw, Architects
Ray Wilde, Detroit, Engineer

Our enclosed TYPE E Equipment embodies the latest improvements in Ozone Generator construction. We have some literature describing it. Write for it.

900 Ton Coal Saving Last Winter—

plus—an odorless, invigorating ventilation in this new building, convinced the Board of Education that, "Ozone Ventilation is Economical."

So—

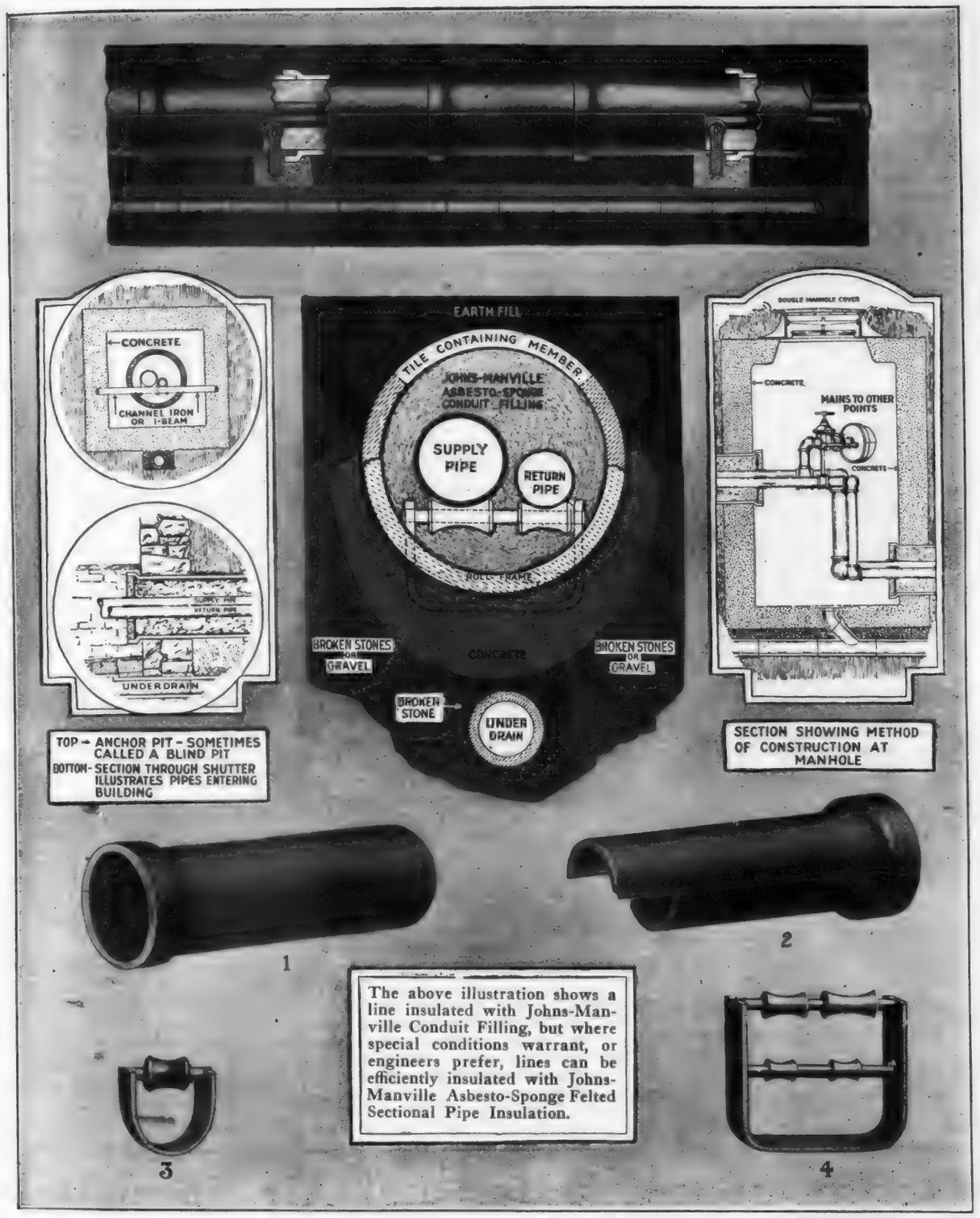
Two more Saginaw Schools were equipped this year—the Manual Training, and the High School. They too, will now enjoy this good ventilation, while saving half their fuel each year.

Ozone Ventilation will effect the same economies in the buildings you are planning.

OZONE PURE AIRIFIER COMPANY

CHICAGO

Ozone Ventilation is Economical Ventilation


CONCRETE
CHANNEL IRON OR I-BEAM
UNDER DRAIN
TOP – ANCHOR PIT – SOMETIMES CALLED A BLIND PIT
BOTTOM – SECTION THROUGH SHUTTER ILLUSTRATES PIPES ENTERING BUILDING
EARTH FILL
TILE CONTAINING MEMBER
JOHNS-MANVILLE ASBESTO-SPONGE CONDUIT FILLING
SUPPLY PIPE
RETURN PIPE
ROLL FRAME
BROKEN STONES OR GRAVEL
CONCRETE
BROKEN STONES OR GRAVEL
BROKEN STONE
UNDER DRAIN
DOUBLE MANHOLE COVER
CONCRETE
MAINS TO OTHER POINTS
CONCRETE
SECTION SHOWING METHOD OF CONSTRUCTION AT MANHOLE
1
2
3
4
The above illustration shows a line insulated with Johns-Manville Conduit Filling, but where special conditions warrant, or engineers prefer, lines can be efficiently insulated with Johns-Manville Asbesto-Sponge Felted Sectional Pipe Insulation.

1. Straight Section. 2. Supporting Section. 3. One-roll Frame. 4. Four-roll Frame.

Johns-Manville Underground System of Insulation

Through Asbestos and its allied products
INSULATION
BRAKE LININGS
ROOFINGS
PACKINGS
CEMENTS
FIRE PREVENTION PRODUCTS

COMPONENT parts and ordinary construction details of the Johns-Manville System are shown above.

These carefully designed elements are adapted to the specific job by experienced Johns-Manville engineers. They are then installed under Johns-Manville supervision. The result is a system which we are able to assure you will be permanently satisfactory, giving an efficiency of at least 90%—frequently more.

JOHNS-MANVILLE

JOHNS-MANVILLE INC., 292 MADISON AVENUE AT 41st ST., NEW YORK CITY
Branches in 62 Large Cities. For Canada: Canadian Johns-Manville Co., Ltd., Toronto

American Radiator Company's Indianapolis branch, at 401 Fenway Building, Indianapolis, it is announced, is now under the management of Roy N. Downs.

Elliott Co., Jeanette, Pa., announces that the Kerr line of turbines have been added to its list of products.

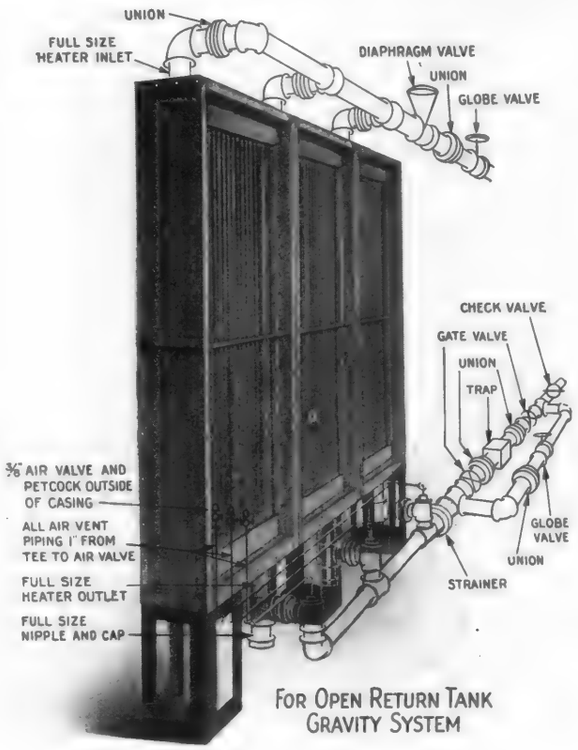
Hudson Boiler Mfg. Co., New York, has moved its main offices to Hoboken, N. J.

Crane Co., Chicago, Ill., announced a 5% cash bonus to employees of the company, also an extra dividend of 1% on the company's outstanding common stock.

O. E. Frank Heater & Engineering Co., Inc., Buffalo, N. Y., has issued an attractive Yuletide greeting card bearing the portrait of Mrs. Olive E. Frank who enjoys the distinction of being one of the few women engineers at the head of their own enterprises. The company manufactures a line of heaters, coolers, condensers and heat exchangers.

Anchor Stove & Range Co., New Albany, Ind., announces the appointment, as sales manager, of M. E. Ticen, formerly of the Monitor Stove Co., Cincinnati, and more recently special sales representative of the Fox Furnace Co., of Elyria, O., a subsidiary of the American Radiator Company. The company has also appointed S. W. Hetherington as vice-president in charge of advertising. Mr. Hetherington was formerly engaged in directing industrial sales for the Monitor Stove Company, and, more recently was advertising manager of the Fox Furnace Company.

EverHot Heater Co., Detroit, Mich., in celebrating the opening of its new plant, in Detroit, December 13, conducted some interesting tests for the benefit of its many guests, as well as



FOR OPEN RETURN TANK GRAVITY SYSTEM

AEROFIN CORPORATION
750 Frelinghuysen Avenue
Newark, N.J.
L. C. Soule, *Sec'y and Chief Engineer*

AEROFIN

Fan-System Heating Surface

TO ENGINEERS AND ARCHITECTS:

Aerofin Saves Space and Weight.

The light weight and non-corrosive features of Aerofin, together with its unit construction, space saving and because it comes to the job already encased and ready for steam connections, demonstrates its superiority, and for this reason we believe Aerofin merits being incorporated in your specifications. Since there is no equal to Aerofin, why not specify it outright?—At least, we ask you to specify Aerofin as a standard and to figure out the exact sizes and number of units required so that the contractor will know what to figure on.

TO THE CONTRACTOR:

SAVE TEN CENTS PER FOOT OF HEATING SURFACE by erecting the (completely encased) Aerofin Units in the same number of HOURS as you would need DAYS to erect the heavy heaters.

SAVE MORE MONEY with Aerofin on account of the smaller number of steam and return connections required.

DON'T FORGET the saving in freight and cartage.

No extra reinforcement of the building construction required with Aerofin—may be suspended from ceiling with small angles and rods, without expensive platforms—may be handled with only ordinary care and assembled without using any block and tackle or scaffolding.

These features demonstrate that you can really save money by installing Aerofin altho the first cost, f. o. b. factory, may be a trifle higher than that of other fan-system heaters.

Illustration shows the ease with which several units high or wide of Aerofin may be assembled together by simply bolting thru the template punched flanges.

Aerofin Is Sold ONLY by Manufacturers of Nationally Advertised Blower Heating Apparatus.

KIELEY
REGISTERED TRADE MARK

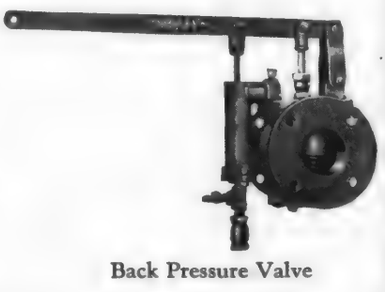
Steam, Water and Air Specialties

Grease Extractor

Manufacturers of the Complete Line

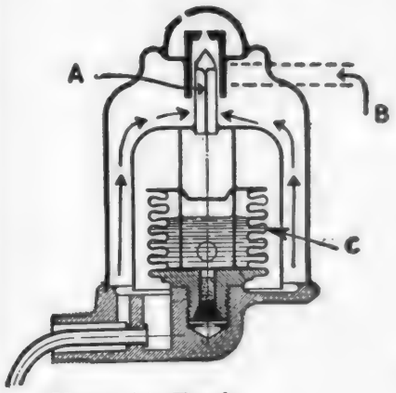
Send for Catalog 1923

KIELEY & MUELLER, Inc.
Main Office and Works
34-38 West Thirteenth Street
New York, N. Y.



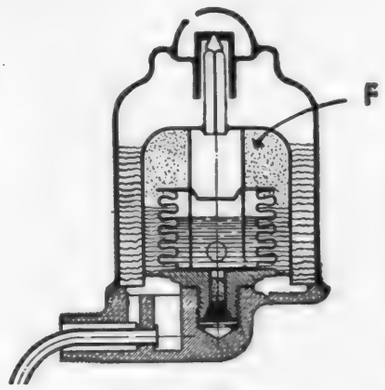
Back Pressure Valve

See how this Radiator Air Valve



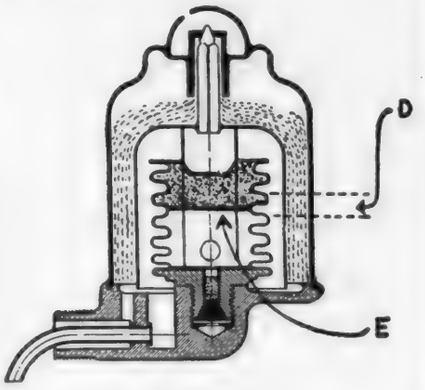
Vents Air Freely

Diagram above shows graphically the situation of cold air passing rapidly outward through extra large venting port. Note (a) square stem in round guide; free clearance for air; (b) long valve travel; (c) Sylphon collapsed on its stop.



Stops Water

Only the Sylphon valve with its extra large bell float has the power to stop water *permanently*. Diagram (above) shows water stopped by extra buoyant float of light construction and large area. Note (f) trapped air forcing bell float to seat.



Stops Steam

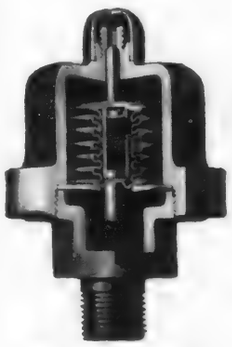
Uses the Sylphon bellows as its themostatic element. Diagram (above) shows hot steam expanding Sylphon has positively closed the valve. No steam leakage. Note (d) long valve travel taken up by expanding Sylphon; (e) thermostatic vapor pressure expands Sylphon.

Has Everlastingly Strong Thermostat

Drawn from a flat sheet of metal without soldered seams, the Sylphon bellows used as the thermostatic element in all Sylphon Radiator Air and Vent Valves is sensitive, powerful, and practically everlasting. Thus with this No. 536 Sylphon Radiator Air Valve, breakdown, so common with the ordinary type of carbon post thermostat, is eliminated, for neither years of constant use nor the powerful action of steam weaken this marvelous bellows.

Two other Sylphon Vent Valves are shown. They, too, contain the everlasting Sylphon bellows as expansion member.

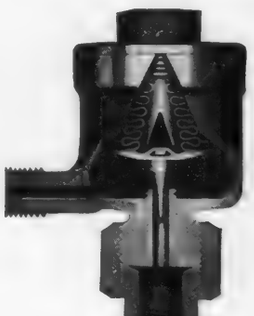
Ask for Bulletin WAV



No. 527—Sylphon Quick Vent Valve

Companion to No. 536. It needs no float because it is always installed above the water line at the ends of the mains and risers. Gives a one-pipe heating system flexibility and double satisfaction. Body of brass, plated all over. Size 2 5/16" diameter by 3 5/16" high.

This can be done hundreds of thousands of times—
AND NO APPRECIABLE LOSS OF FLEXIBILITY WILL DEVELOP IN THE ALL METAL, SEAMLESS SYLPHON BELLOWS
Sylphon



No. 410—Sylphon Air Line Valve

Vents air from radiators on air line systems. Sylphon bellows guarantees the closing of the outlet port, preventing escape of steam into the air line. Has ¼" male thread on inlet side and ¼" female thread on the outlet.

THE FULTON COMPANY KNOXVILLE, TENN.

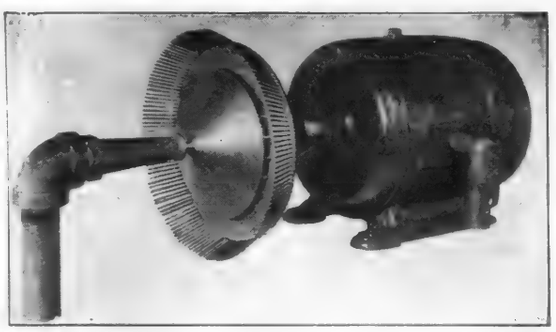
Sales offices in NEW YORK CHICAGO DETROIT BOSTON PHILADELPHIA *and all the principal cities in U. S.*
European representatives: Crosby Valve & Engineering Co., Ltd., 41-42 Foley Street, London, W. 1, England
Canadian representatives: Darling Bros., Ltd., 120 Prince Street, Montreal, Canada

showing them the equipment of the plant and the construction methods followed in the manufacture of EverHot heaters. The guests were received by President Frank Shuell and Director of Distribution Elmer E. Ledbetter. After a buffet luncheon, the party was conducted in groups through the plant where the exhibits and apparatus were placarded so as to show at a glance the various operations. It was stated that the plant's present capacity of 200 heaters per 8-hour shift will be increased early next year when additional buildings are constructed no the company's property, which now extends 336 x 300 ft.

The test conducted during the opening was in connection with the operation of the gas burner and thermostat used with the heater. A pressure of 40 in. of gas was thrown on the burner and thermostat, which operate normally under a pressure of 4 in. In another test, made to demonstrate the amount of heat distribution in the EverHot construction, the bottom of the heater was filled with 4 in. of sand. One of the purposes of this test was to demonstrate the fallacy of the belief that the bottom of the heater is subjected to too intense a heat, and another was to show the effectiveness of the heater with water having a large lime content. Despite the layer of sand the test showed no impairment of the efficiency

New Plant of EverHot Heater Company, in Detroit, and Group of Officials

(At upper right) View Through Main Aisle of New Building. (At lower left) Hart & Crouse Boiler Equipped for Burning Oil Preheated in EverHot Heater. (At lower right) Standing, left to right, C. C. Fox, field manager; Walter I. Vallette, Detroit branch manager; J. Agnew Appelhof, assistant to president. Sitting, left to right: Frank W. Shuell, president, Elmer E. Ledbetter, sales manager.



The Turbo Atomizer

The Turbo Atomizer is the heart of Bayley Air Washing Systems. It does away with multiple orifice sprayers which are easily clogged and which produce a spray not altogether free from holes.

It operates with low current consumption and at very low water pressure, throwing an even, finely divided spray radially against the walls of the washing chamber.

Three Types are Built Around this Principle

Type "A" **For washing and humidifying (cleaning).** The Type "A" Washer is installed where cleaning is the primary consideration. It uses the water over and over, and removes 98% of foreign matter from the air. Humidity may be added as desired.

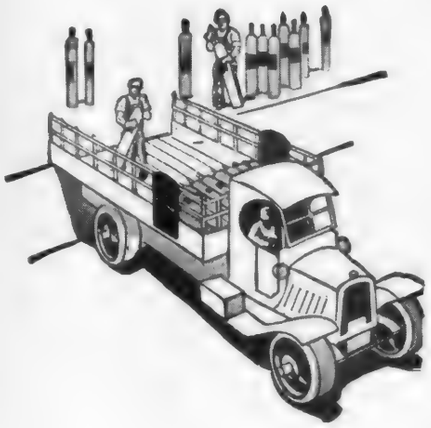
Type "B" **For washing and de-humidifying (cooling).** For cooling air, the cleaning being incidental, Type "B" Washer, consisting of tandem sprays, is installed, and is capable of bringing the temperature of the entering air practically to the water temperature.

Type "C" **For washing without humidifying (drying).** Where clean air for drying processes must be obtained without increasing its humidity, the Type "C" Washer is installed, using a special washing emulsion.

Bayley

Manufacturing Company
742 Greenbush Street
MILWAUKEE

What is Linde Service?



Its broad scope is shown by the following typical examples:

1. **Product Service.** Linde engineers discovered how to produce pure oxygen in volume and at low cost. They developed the Linde Type K cylinder which replaced clumsy containers of small capacity. This cylinder is now the accepted standard in the entire industry. Linde engineers also found why valves leaked and built one that wouldn't.
2. **Distribution Service.** Linde executives saw why one big central plant would not insure a supply and how a national chain of plants and warehouses would give each user a dependable and convenient supply with low freight cost. Linde transportation engineers saw the opportunity for truck delivery and planned a trucking service that is always on time.
3. **Process Service.** Linde service is built to serve the smallest user and the largest; with its aid the user solves problems ranging from repairing auto radiators to reclaiming huge castings, from joining small parts of airplanes to welding the joints in hundreds of miles of large diameter pipe, from shaping small plates to dismantling battleships. Linde Process Service is free to every Linde user for the asking.
4. **Contact Service.** Linde saw the need for dependable and responsible local men with authority, and built such a national sales organization, with local offices whose first duty is to serve the customer.

Linde service is the doing of everything which will make Linde oxygen of greater value to Linde customers—but doing it under a definite plan which provides the men and means to bring Linde help in close touch with your needs and problems on the ground.

District Sales Offices

ATLANTA
BALTIMORE
BIRMINGHAM
BOSTON
BUFFALO
CHICAGO
CLEVELAND
DALLAS
DETROIT
KANSAS CITY
LOS ANGELES
MILWAUKEE
NEW ORLEANS
NEW YORK
PHILADELPHIA
PITTSBURGH
ST. LOUIS
SALT LAKE CITY
SAN FRANCISCO
SEATTLE
TULSA

THE LINDE AIR PRODUCTS COMPANY

General Offices: Carbide & Carbon Building
30 East 42d Street, New York

37 PLANTS — 80 WAREHOUSES

LINDE OXYGEN

YOU CAN DEPEND ON THE LINDE COMPANY

of the heater. The stack loss, as indicated by instruments recording the flue-gas temperature, the temperature of the combustion chamber and the temperature of the water in the heater, was 3%. No loss in the water temperature was observed over a period of seven hours, this curve showing a gain for every hour.

A test of the insulation used with this heater was made by applying an open flame to a pan filled with granulated insulation. It was found to be cool to the touch while the pan itself was hot.

A heat interchanger exhibit, comprised of a Junior EverHot heater connected through an Excelso heater to an Ideal Arco round boiler, was demonstrated by R. E. Moore, of the Excelso Specialty Works. A unit system of hot water equipment for from 10 to 20-family apartments was shown, comprising two EverHot heaters in balanced connection with a 400-gal. tank. Other exhibits showed a variety of similar applications, one in particular demonstrating the efficiency of the thermostat. A pan of hot water was connected to the thermostat and the water in the pan cooled every minute, causing the thermostat to operate at 1 minute intervals.

Interest was manifested by many in the dust-proof spray room, with muslin air filter, where the satin silver duce finish is applied to the heaters.

The plant itself is heated by a Hart & Crouse type boiler, supplying 5,000 sq. ft. of vapor radiation. Low-gravity fuel-oil is used in this boiler, the ash-pit door being bricked in with the exception of a small opening at the center. Directly outside of this opening is located the spray-head of the oil burner. The fire-box is checkered with fire-brick. The air and oil enter through the hole and are mixed about 6 in. from the spray head. Preheating of the oil is accomplished through a Junior EverHot heater which is arranged to control the oil temperature and is connected with an Excelso water heater. Oil consumption is at the rate of 30 gal. an hour with a 60° raise of 60 gal. per hour. The overflow is returned to the tank and is used to keep part of the tank warm. A separate oil pump is used to keep the oil in circulation 24 hours a day.

WANTED

Advertisements under this heading, $2.00 per inch, payable in advance. A 1-in. advertisement contains 35 words. To secure insertion copy must be received not later than the 20th of the month preceding date of issue.

SALES ENGINEER WANTED—Sales engineer acquainted with heating and ventilating trade to represent, in special territory, superior hot-blast heaters. Liberal arrangement to a capable, live wire. Address, with experience and qualifications, Heating, 710 Union Trust Building, Chicago, Ill.

POSITION WANTED — Engineer, young man, 25, with practical and theoretical training in heating and combustion, wishes position anywhere. Address Box 11, care of Heating and Ventilating Magazine.

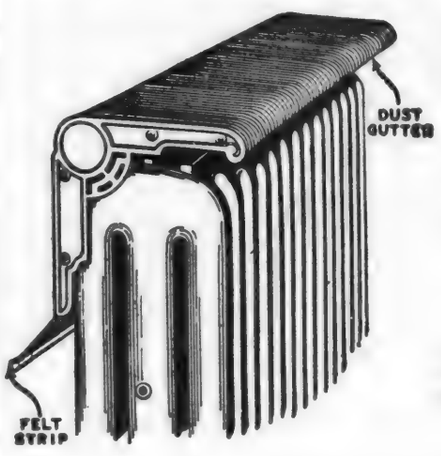
WATCH THE CANADIAN MARKET—We offer facilities in Canada for manufacturing, assembling, warehousing or distribution. Coast-to-coast connection in heating trade. Address Box 124, care of Heating and Ventilating Magazine.

POSITION WANTED.—Young engineer, age 24, technical graduate, three years' experience in heating and ventilating estimating, designing and specification work, desires connection with reliable contractor or in architect's office. Address Box 12, care of Heating and Ventilating Magazine.

SALESMEN WANTED.—Salesmen wanted for several good territories to handle well-established heating system. Commission basis. Side line no objection. Address Box 14, care of Heating and Ventilating Magazine.

SALES REPRESENTATIVES WANTED—Some attractive territorial openings are available in Gulf States, also in vicinity of Los Angeles, for sales representatives properly qualified to handle steam specialties, temperature-control apparatus and ventilating fans. Liberal commission proposition. Write in detail. Address The Bishop & Babcock Co., Cleveland, O.

ACME RADIATOR SHIELDS



are a necessity in every home or building.

All Metal Design

Protection to walls and draperies is guaranteed

ACME shields are neat in appearance, strong and durable.

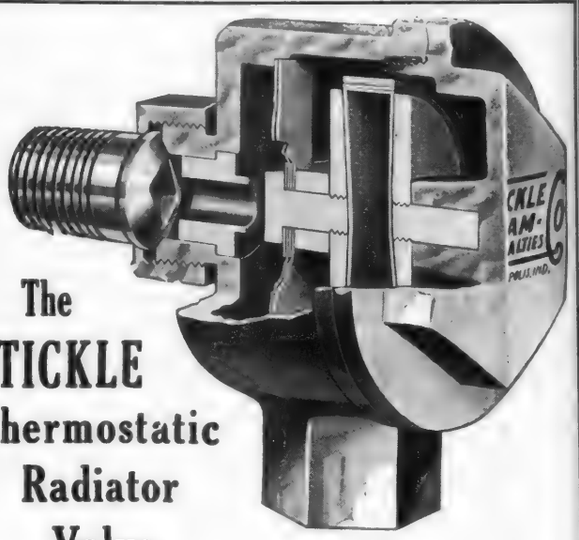
The price is right. Shipments are prompt.

Live aggressive agents are wanted.

Write for Particulars

ACME RADIATOR SHIELD COMPANY

320 Central Office Building Cincinnati, Ohio



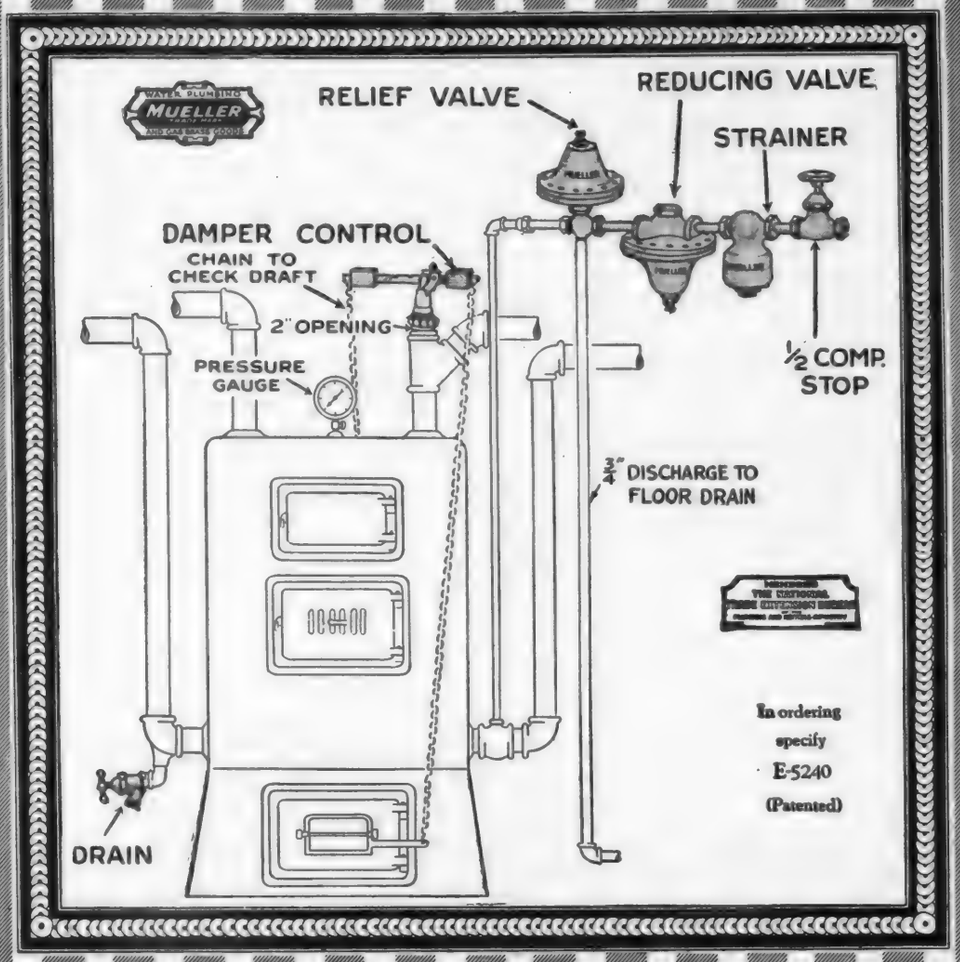
The STICKLE Thermostatic Radiator Valve

The Expansion principle in return line Radiator Traps is not novel or new. Consequently the difference in this class of Traps is in the construction.

The expansive movement of this diaphragm is fully one-quarter inch, which is much more than is necessary for opening and closing the valve. This gives a factor of safety which is greater than any valve made, consequently it requires no adjustment. May we send you our bulletin?

STICKLE STEAM SPECIALTIES CO.
INDIANAPOLIS, IND.

New York Office 46 E. 41st St. Boston Office 52 Sudbury St.



How to Stop Future Complaints

Complaints hurt any dealer. You can stop future complaints from your customers regarding their heating systems by selling and installing the

MUELLER

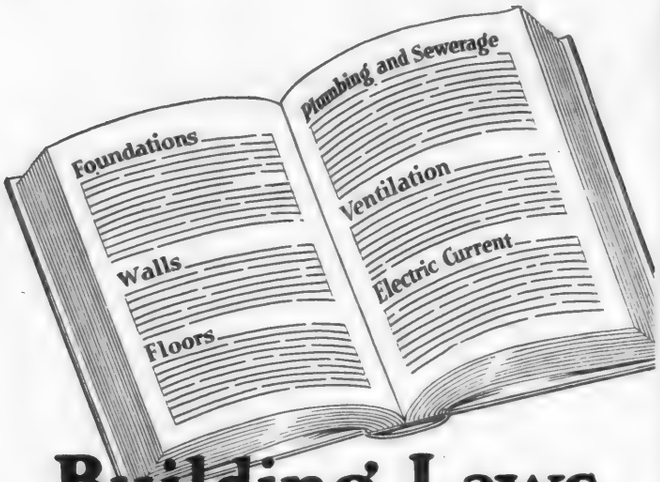
Automatic System of Hot Water Heat Control

It is shipped already assembled—has no useless and expensive expansion tank—operates on city water pressure—insures steady, even heat automatically.

Write us for detailed descriptions or order through your jobber.

Mueller Co., Decatur, Illinois, U. S. A.

145-149 W. 30th St., New York; 1072-76 Howard St., San Francisco; 2468 Hunter St., Los Angeles



Building Laws Specify Everything

—except an adequate heating plant

Today, building laws, based on scientific research, specify the safe carrying capacity of foundations and floors—the required thickness of walls—the amount of electric current which may be transmitted over the wiring system with safety. These laws set a definite standard for plumbing, for sewerage, for ventilation—for every factor which contributes to the safety and health of the occupants—*except the size of the heating plant necessary to provide adequate comfort.* This is still a matter of individual opinion and guesswork.

Under these conditions, the numerous heating plant failures are not surprising. Such failures can be traced directly to the lack of scientific knowledge of determining heat losses in a building, particularly in regard to infiltration.

By hundreds of tests, The American Society of Heating and Ventilating Engineers, working under the direct supervision of the American Institute of Architects, has proved conclusively that the difference in infiltration thru various types of weather strips is fully as great as the difference in the carrying capacity of various types of foundations and floors.

If results developed by scientific research were sufficiently acceptable to be written into the building laws of the country, should not the engineering data on infiltration (inleakage of air around windows and doors) developed by the scientific research of the A. S. H. & V. E. be accepted as standard for figuring radiation and the consequent fuel consumption?

Accurate data on infiltration, with names of authorities responsible for it, is yours for the asking. Write for data sheets.

MONARCH METAL PRODUCTS CO.
5060 Penrose St. St. Louis, Mo.
Representatives in All Principal Cities

MONARCH
METAL WEATHER STRIPS

INTERLOCKING TYPE NO. 400
STANDARD CONTROL OF AIR INFILTRATION

KNOWLES MUSHROOM AIR DIFFUSERS
FOR AUDITORIUMS

Have meant comfort to thousands of audiences.

Either cool or warm fresh air evenly distributed.

Write for our booklet today

KNOWLES MUSHROOM VENTILATOR CO.
202 Franklin St. New York

"Weight" Does Not Interfere With Correct Location of the WING FEATHERWEIGHT

Eight small bolts support this High Ceiling Type Wing Featherweight Unit Heater. Easily installed without alterations or extensive piping.

The great bulk and tremendous weight of old style heaters permit of only one location—on the floor. Their weight allows no choice (except at considerable expense for special supports).

The success of the Wing Featherweight Unit Heater is due primarily to its proper location—overhead, made possible by its small dimensions and extremely light weight.

From the position illustrated above, the Wing Featherweight Unit Heater heats the working level first, maintains an even temperature, and prevents the accumulation of warm air at the ceiling—all because of the fact that from the point at which it is installed it sets up a vertical circulation from ceiling to floor.

L. J. Wing Mfg. Co.

Fans and Blowers *Damper Regulators*
Unit Heaters *Small Turbines*
Hudson & 13th Sts. New York City

NATIONAL HORIZONTAL SUPER-HEATER

MULTI-RADIATOR TYPE

SCIENTIFICALLY DESIGNED FOR FAN BLAST SYSTEM OF HEATING AND VENTILATING

A DIRECT FIRED HEATING UNIT THAT HEATS 10,000 CUBIC FEET PER MINUTE FROM—20° TO 120° + AT A RATE OF EFFICIENCY THAT DEFIES COMPARISON

HEATING ~ VENTILATING ~ DRYING

BURNS COAL—WOOD—OIL

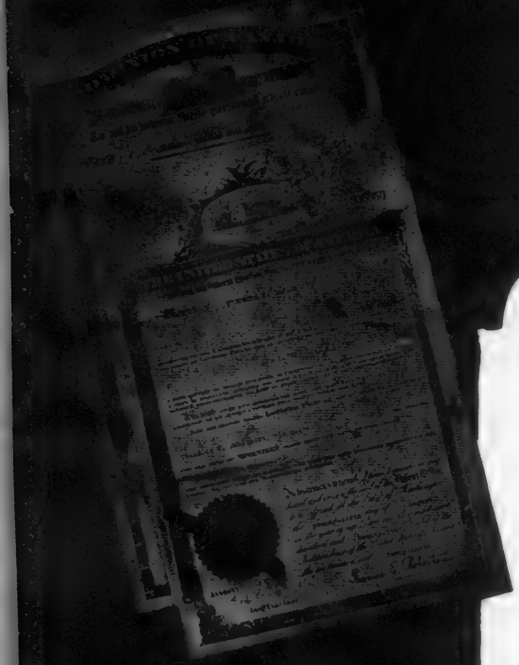
HUNDREDS OF THESE NATIONAL SYSTEMS INSTALLED THROUGH OUT THE COUNTRY IN SCHOOLS, CHURCHES, THEATRES AND INDUSTRIAL PLANTS ARE SERVING OWNERS AND THE PUBLIC, AND WE HAVE TESTIMONIALS OF THEIR HIGH EFFICIENCY AND LOW MAINTENANCE COSTS

WRITE TO-DAY FOR INTERESTING BOOKLET ON THIS MASSIVE HEATER

WAUSAU VOCATIONAL SCHOOL
WAUSAU, WIS.
EQUIPPED WITH THE
NATIONAL SYSTEM
80,000 CUBIC FEET PER MINUTE OF FRESH WARM AIR

P. H. MAGIRL
FOUNDRY AND FURNACE WORKS
BLOOMINGTON, ILL.

Instantaneous Hot Water



ON THE twenty-fifth anniversary of the Dahlquist Mfg. Company, Mr. Theodore Dahlquist is pleased to offer the DAHLQUIST AQUATHERM COPPER RANGE BOILER to provide INSTANT HOT WATER as soon as fire is lighted.

This is the first improvement in Range Boiler Construction in many years and will provide instant hot water to the Consumer at minimum cost and show a handsome profit to the plumbing contractor.

The Dahlquist Aquatherm Copper Range Boiler

will reduce by one-half the cost of installing a gas tank heater on any job and will provide the consumer with all the convenience of an instantaneous heater either from the ordinary gas tank heater, water back in coal range, indirect heater or coil in boiler or furnace or electric heater as the hot water is conducted direct from the heating source to the faucet. When the faucet is turned off the hot water is discharged through ports into the range boiler which immediately becomes a storage system, therefore you have three in one,—Range Boiler, Instantaneous Heater and Storage System.

The Dahlquist Aquatherm can also be furnished separately to be installed in any other range boiler now in use whether the water is to be heated by gas, coal, wood or electricity at a cost of $10.00 list.

The Dahlquist Aquatherm Copper Range Boiler and the Dahlquist Aquatherm itself are fully protected by patents in United States and Canada.

DAHLQUIST MFG. COMPANY

30 WEST 3rd STREET SOUTH BOSTON, MASS.

The Ideal Time To Sell Heating Service is NOW!!

Right now is a good time to talk heating service, while many of the plants in your vicinity are suffering from poor heating, and plans are being made for the year.

For plants that need some reliable method of heating and need it right away, you can safely recommend the

"Buffalo" Unit Heaters

These are quick action heaters that are guaranteed to HEAT. The direct-fired type shown at the left is economical, since refuse or waste material of any kind may be burned with excellent results. The only connection necessary is a pipe to the chimney.

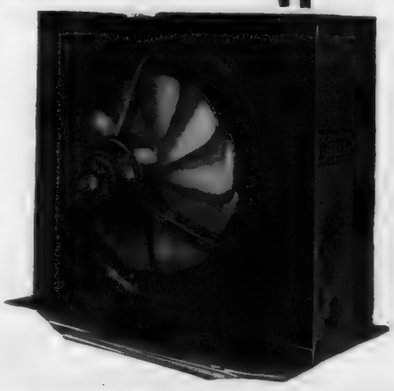
The other heater (right) is very light and compact, with light fin-tube steam coils for radiating heat.

Both heaters use the Buffalo Breezo Fan to distribute the warm air.

You will be interested in a complete description of these two outfits, and surprised at the enormous capacity in c. f. m. of each. Write for bulletins.

Buffalo Forge Company
480 Broadway - Buffalo, N. Y.

When working on large heating jobs remember that Buffalo equipment is well known and guaranteed as to results. We have apparatus to fit all conditions, all of one quality—"the best." Why not ask us to quote on your work?



Athey

(Patented)

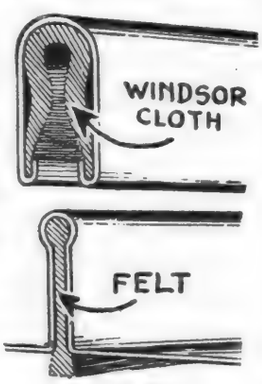
Cloth-Lined Metal Weatherstrip

Quickly save their cost

The experience of owners proves that Athey Cloth-Lined Metal Weatherstrip reduces the amount of coal used so materially, that ***the entire cost of installing is saved in a short space of time.***

For instance: Athey Cloth-Lined Metal Weatherstrip in one big Chicago building effected a coal saving, based on their report covering five months equal to $3,400 at the present price of coal. The cost of the strip was $4,900. **Which means that in less than two years time the coal saved would pay the entire cost of the Athey strip.** These are actual figures given us by the engineer of the building.

Athey Cloth-Lined Metal Weatherstrip is the ***only*** cloth-lined metal weatherstrip made. And a cloth-to-metal contact is the only one that keeps out all drafts and cold without making the windows stick.



Double Size

Can be applied to wood or metal sash

Athey Cloth-Lined Metal Weatherstrip can be applied to either wood or metal sash. A special strip is furnished for metal sash, giving a cloth and spring bronze contact. The cloth and bronze are sufficiently resilient so that even when the sash is not absolutely "true" the contact is perfect.

Athey Products

SEE OUR CATALOGUE IN SWEETS

Perennial Window Shades, Cloth-Lined Metal Weatherstrips, Athey Disappearing Partitions
Athey Skylight Shades

Write for complete information and prices

Athey Company

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Lyon Toad Stools for Ventilation

Are Vent Caps of great strength, unobstructed throat, rigid non-rattling construction. The adjustment is from full open to full closed. The height of the floor member prevents sweeping dust and refuse into them. Their efficiency and economy make them particularly adaptable for theatres, auditoriums, etc.

Send for table of capacities and velocities

LYON PRODUCTS COMPANY
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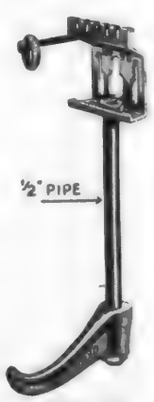
EZ RADIATOR HANGER
YOU'LL USE 'EM YET!

For ANY wall, fits ANY radiator.

One bolt per hanger, which does not require accurate placing. A style with or without baseboard adjustment.

Hangers invisible when installed.



Style R

Write Us for Complete Details

Healy-Ruff Co.

772 Plymouth Bldg., Minneapolis, Minn.

How Much Dust Is Contained in City Air?

Here are some authoritative test figures that may not check with your own ideas on the subject. They are the result of a series of ten month tests conducted by the Mellon Institute of Industrial Research in three large cities. These tests were made in a number of stations in each city, to determine the amount of insoluble matter deposited from the air.

The figures are expressed here in pounds of dust per square mile per year.

Pittsburgh .....3,000,000 lbs. per sq. mile per year
St. Louis .....1,320,000 lbs. per sq. mile per year
Cincinnati .....1,056,000 lbs. per sq. mile per year

Pittsburgh soot and dust is notorious. But a million pounds of dust per square mile per year in cities like St. Louis and Cincinnati indicate a rather dusty condition! Incidentally a comparison of these tests with a similar series made ten years ago showed an increase in ten years of around 50%!

These figures surely indicate that the solution of any city ventilating problem must include some equipment for cleaning the air.

MIDWEST AIR FILTERS

have long since demonstrated their right to a place at the head of the list of air cleaning equipment, by practical and satisfactory service on all kinds of installations.

We are ready to cooperate with you in the solution of ventilating problems affected by the dust in the air.

The New Model Type U2
Patents Pending

For Complete Information and Data Write Dept. F4

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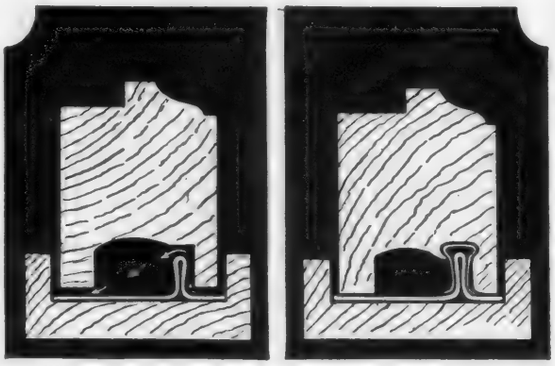
ALL METAL
WEATHER STRIPS



Ordinary single-member strip Sash grooved for cord — *The exclusive Higgin Insert Strip completes the job*

Are you recommending the right weather strips?

The only weatherstrips made with a self-holding spring-flange **Insert** are Higgin All-Metal Weatherstrips.

No window without this **Insert** can be as draft-tight as a Higgin-equipped window. The illustration shows why.

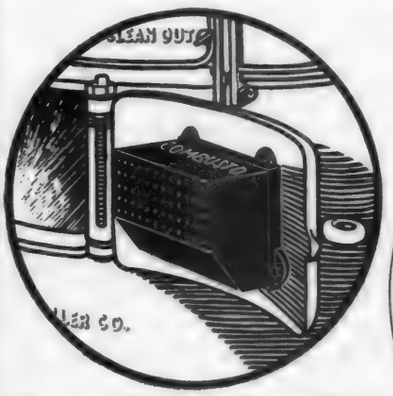
The spring flanges of the **Insert** lightly grip the sides of the raised rib and close the space around the sash at every point. There is no air leakage where the sash is cut out for the cord, nor seepage around the rib when the sash shrinks. The metal-to-metal contact insures a perfect fit and closure; also an easy-sliding sash under all conditions.

A Higgin Installation means added comfort, greater fuel saving, increased satisfaction with the heating system.

HEATING ENGINEERS! You can safely guarantee a definite heating efficiency for your equipment when Higgin All-Metal Weatherstrips are installed. They keep all the cold air out and all the warm air in. They never lose their close fit by warping or shrinkage of frames. Every job is installed by trained Higgin men and guaranteed by the Higgin organization. Recommend Higgin All-Metal Weatherstrips to your customers.

The HIGGIN Mfg. Co.
Newport, Ky.
Toronto, Canada.

Manufacturers of Higgin All-Metal Weatherstrips and Higgin All-Metal Screens



Saves 10% to 30% coal.—This guarantee made on any type of heating plant burning large or small sizes of hard coal, soft coal or coke.

Your Exclusive Sales Argument

COMBUSTO equipped, the fuel economy of the heating plants you sell over all competitive plants is a clinching sales argument which you alone can use.

Because Combusto saves coal, reduces ash, clinkers, soot, eliminates coal gas, and maintains an even heat from fewer number of firings, it is the only devise of its kind endorsed by leading heating and ventilating engineers.

Heating contractors of high standing are invited to communicate with us for exclusive distributor rights in their territory.

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AIR CONDITIONING TRADE MARK

APPARATUS for maintaining artificial atmospheric conditions in industrial plants.

ATMOSPHERIC CONDITIONING CORPORATION
LAFAYETTE BLDG.
PHILADELPHIA

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Grant Smith & Co. Contractors *Meyer Strong & Jones Engineers*
George B. Post & Sons, Architects

A Perfect Combination—
Gives Superior Ventilation

Sturtevant Silentvane Fans and Sturtevant Air Washers supply perfect ventilation to the patronage of Seattle's newest hotel—The Olympic.

This is just one of the many prominent buildings throughout the country where Sturtevant Silentvane Fans and Sturtevant Air Washers are installed.

Sturtevant Silentvane Fans—true to their name—run with less noise at higher speeds, and have a higher efficiency than any other fan built today.

Sturtevant Air Washers are as highly efficient in cleansing the air as Sturtevant Silentvanes are in supplying it. By means of these air washers, the air, which is drawn in from the outside, is thoroughly cleansed and Sturtevant Silentvanes efficiently distribute it.

The best service that we can render to architects and engineers is to supply the finest ventilating apparatus that will perform in accordance with their plans, and this, we are doing. The satisfactory operation of Sturtevant Silentvane Fans and Sturtevant Air Washers makes this combination for ventilating unexcelled.

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1170

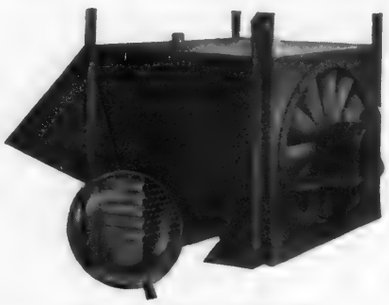
COLD WEATHER IS COMING

Why Let That Unheated Building Worry You

We manufacture Unit Heaters and Fan Heating Systems for every need. If steam is not available, our all steel direct fired Fan Furnace will meet your requirments.

Send us your heating problems and we will show you the easiest and cheapest way.

Recommendations and prices furnished cheerfully without cost to you.



COMET UNIT HEATER

Suitable for use where steam and hot water is available. This Heating Ace is especially adapted where compactness and lightness in weight is of importance. For complete description write for Bulletin No. 85.

DIRECT FIRED FAN FURNACE

For use where steam or hot water is not available. For complete data write for Bulletin No. 90.

THE NEW YORK BLOWER COMPANY

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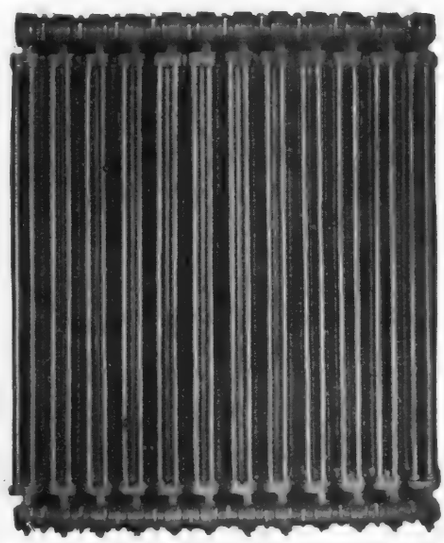
Why the Lyon Interlocking Heaters are Best for Hot Blast Heating



Front View of Lyon Heaters

Thousands of feet in daily use under pressure up to 100 lbs.

Some Territory Still Open to Reliable Agents

BECAUSE Guaranteed against cracked or broken sections under steam pressure up to 100 lbs.

—Light in weight, avoiding expensive foundations or supports where used on upper floors or roofs.

—Made to fit in space of any height from 40 inches to 140 inches in steps of 10 inches, thus avoiding piling up or decking.

—Made in small units that can be assembled in the building, and handled through any window, door or small opening.

—Heating surface closely assembled, thus giving greater heating surface in smaller space.

—All prime heating surface with the resulting high efficiency.

—Are pipe heaters, admitting steam at the top, the force of which drives the air down to the air vents at the bottom, thus assuring rapid and uniform circulation.

—Have all advantages of old style pipe heaters (in satisfactory use for forty years), with objectionable features of bulk and weight removed.

—Made of full strength Spellerized pipe, virtually rust and corrosion proof.

—Headers and bases are pressed in by hydraulic pressure without threading—sections assembled with extra heavy right and left nipples.

—Designed for extreme conditions, such as 40° below zero intake temperature and velocity up to 2000 feet per minute, under which conditions of temperature, humidity and velocity, the condensation becomes excessive.

—Price compares favorably with that of other heaters, and their light weight saves on freight. Cost of installation also much less..

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BUCKEYE HEATOVENTS

were selected for this fine building because actual tests proved they were best. They are supplying over Seven Million Cubic Feet of warm, filtered air every hour.

For finer structures such as this, where the best in mechanical equipment is the standard, Heatovent is the logical choice of all ventilating systems. For Heatovent combines perfect mechanical operation with unusual dignity of appearance, simplicity, convenience and serviceability.

The simplicity of construction of Heatovent assures long life and service uninterrupted by mechanical troubles. Any contractor can make Heatovent installation without difficulty and at very low labor costs. In addition, this company maintains a corps of engineers always available for consultation with you.

Write our nearest branch office or direct to the factory.

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Skinner Bros

Baetz Patent HEATING SYSTEM

Don't Let Cold Weather Control Your Factory Production

Keep your factory warm, your workers comfortable, this winter and you need not have any fear about holding up your production. To yield to cold weather, through a common grade of heating equipment, is direct discrimination and contrary to the best methods employed today by hundreds of prominent manufacturing and industrial concerns. Business prospers only through the use of the most practical and economical systems it can obtain. Therefore, the money you use for heating your factory this winter will determine to a great extent, if you can deliver your production quota at the price you can afford to pay.

Heats Best Costs Less Saves Most

Skinner Heaters will maintain a uniform, comfortable temperature, permeating the remotest corners and recesses of the open spaces of any type of building or size of space to be heated. This is accomplished regardless of weather conditions. Skinner Heaters are portable and can be moved from one place to another. Completely assembled before shipment. Constructed in the floor type and inverted type for overhead suspension. No outside pipes or ducts are used for air distribution. Performance is positively guaranteed when installed as directed by our engineers.

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Skinner Bros Manufacturing Co. Inc.

Sole and exclusive manufacturers of Skinner Bros Baetz Patent Heaters and Skinner Bros Patented Direct Fired Heaters
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Skinner Bros Baetz Patent Heater, uses live or exhaust steam at high or low pressure. Where steam is not available we furnish Skinner Bros Patented Direct-Fired Heater which burns coal, coke, wood, gas or oil.

¶ **Our trained staff of experts will advise, without obligation, with Executives, Engineers, Superintendents and Managers concerning heating, ventilating and air conditioning systems for factories of every type and size.**

A Scientific Method of Burning Coal and Coke

CROWN FUEL SAVER

and SMOKE *Consumer*

Fits the feed door of any heating plant. Saves 20% or more of coal. Practically eliminates all black smoke.

The CROWN Fuel Saver produces a given amount of heat from considerably less coal by burning the heat-laden gases that are ordinarily lost up the chimney. (See illustration.)

Write for Full Details

Heating engineers are invited to write for full details of this scientific coal-saver and heat-producer and for our special DEMONSTRATION OFFER.

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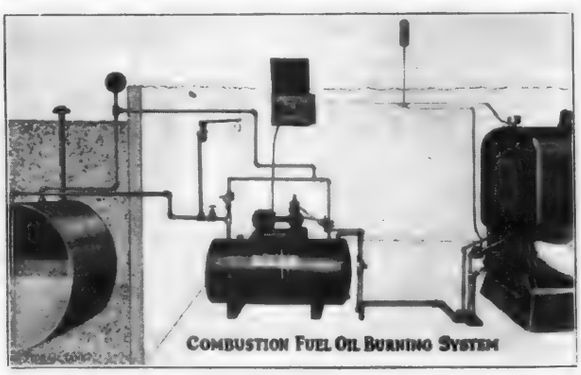

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No Building Too Big or Too Small—Fits Them All

There is no system like the Combustion Fuel Oil Burner for flexibility. The Combustion is suited to all uses—for homes, garages, office buildings, apartments, factories, industrial uses. Also hot water supply systems. Capacity may be increased by addition of units. No costly changes necessary. Gives you the biggest oil burner sales field. A big, sure money-maker. Write today for complete information.

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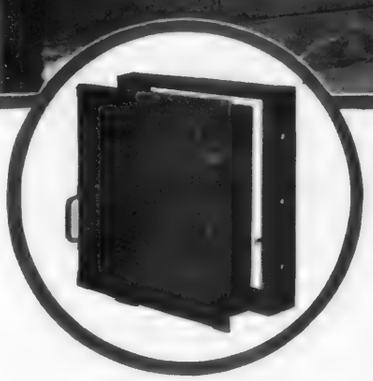
Milwaukee, Wisconsin

The Combustion Fuel Oil Burner

REED AIR IS CLEAN AIR



A small ventilating system in the PRODUCE STATE BANK, *Minneapolis. Reed Air Filter and fan installed over door-way.*

Flexibility is one of the principal advantages of the REED System of air filtration. Built as a unit, the Reed Air Filter can be arranged to meet any capacity or space requirement.

Guaranteed to remove 97% of all dust, soot and bacteria from the air. No water to freeze —no moving parts to get out of order. Simple to install and automatic in operation.

Sold on the "*Try Before You Buy*" plan. Recommended by leading architects and engineers. Investigate! Write for Bulletin No. 107.

REED AIR FILTER COMPANY, Inc.
215 Central Ave., Louisville, Ky. 50 Church St., New York City
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REED AIR FILTER COMPANY, Inc.
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Gentlemen: Please send me without obligation your informative folder, "Are You Interested in Clean Air?"

Application.....C.F.M.

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Name.....

Address .....

Reed Air

TRADE MARK

filters ALL METAL

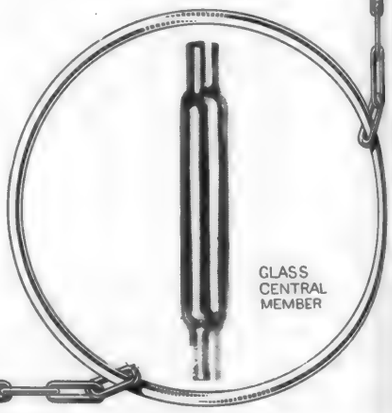
Corrosion

IT IS IMPOSSIBLE TO METER OZONE ELECTRICALLY WHEN THE OZONIZER IS CONSTRUCTED OF MATERIALS SUBJECTED TO ATTACK BY OZONE AND ELECTRONIC BOMBARDMENT.

Aluminum and *Glass* are *unaffected* by dry ozone or electronic bombardment.

U. S. Ozonizers utilize only glass and aluminum for the interior construction of the ozone generator. All *organic* and *laminated* substances are strictly *excluded.*

We maintain our own Research Laboratories and Engineering Staff. Technical publications on OZONE sent on request.



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Chicago	San Francisco	New York
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General Sales Agents for

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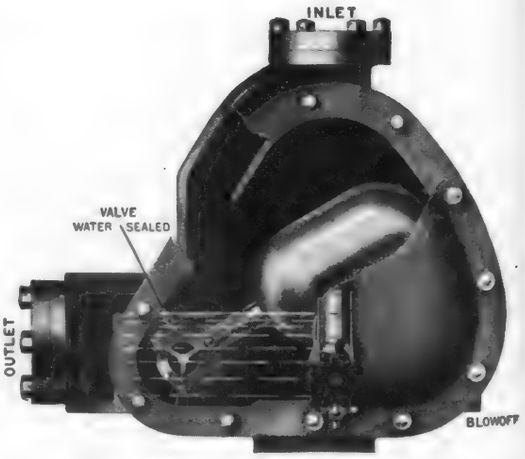

Interior view (elevation) Nos. 3 and 5

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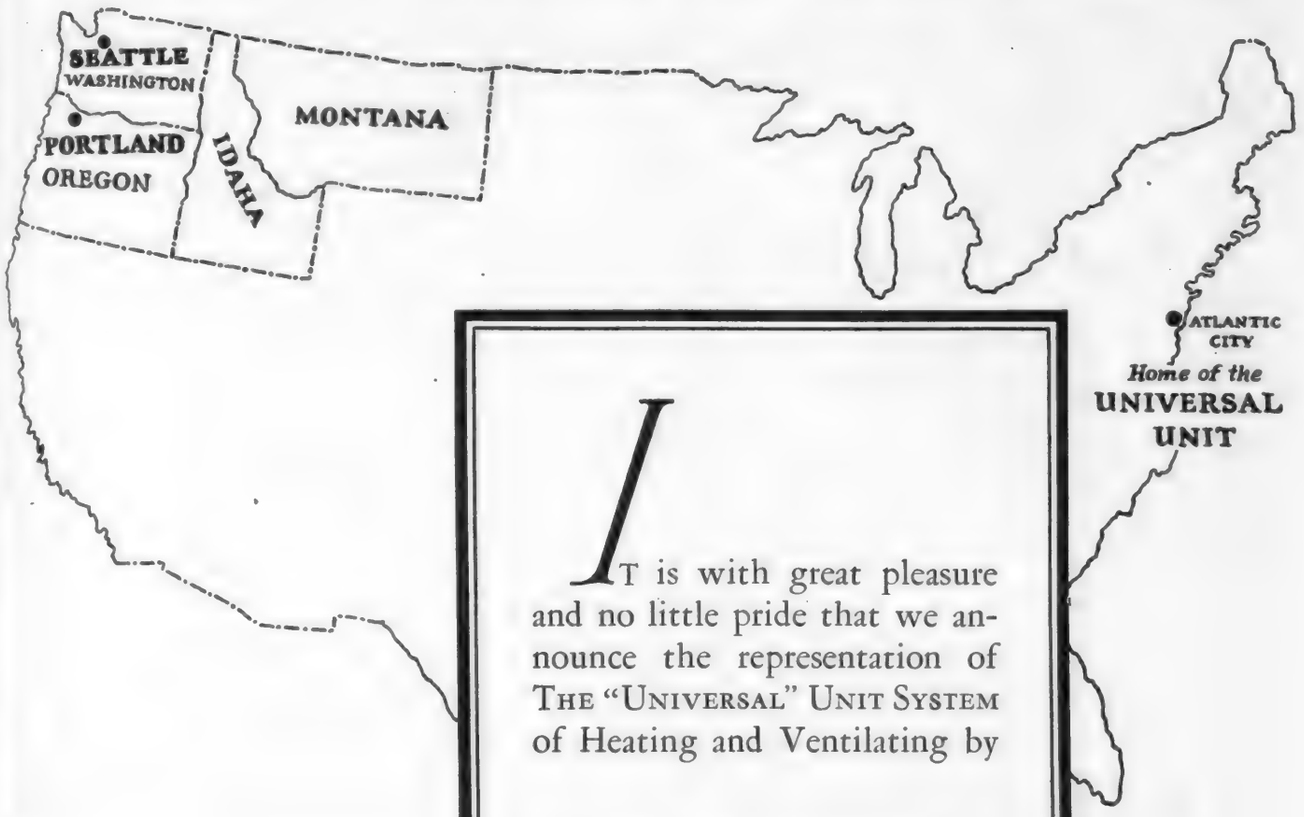

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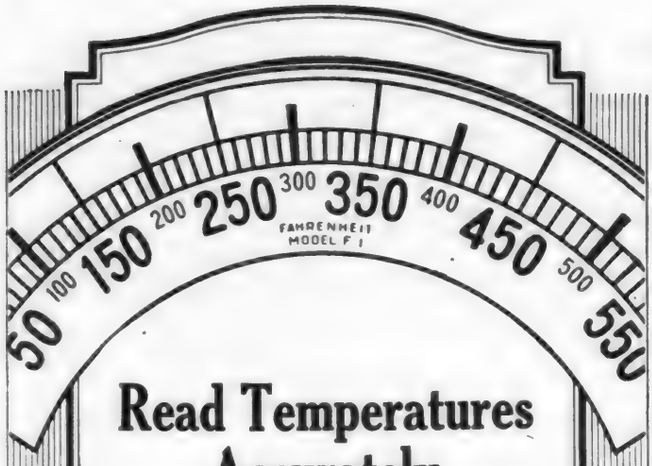

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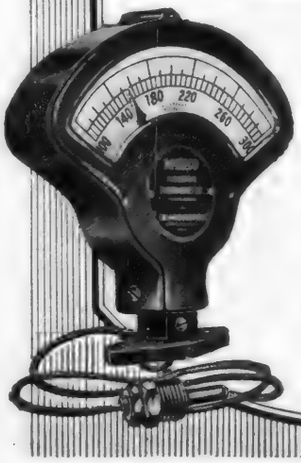

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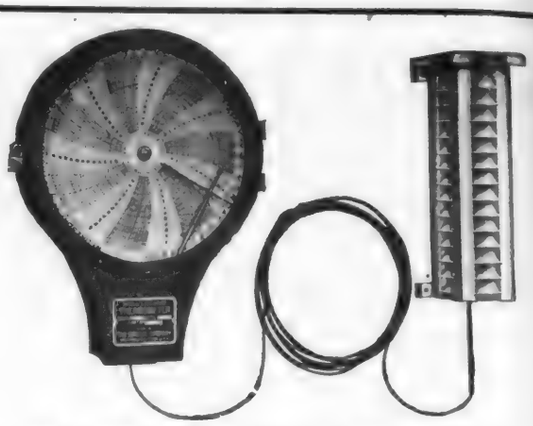

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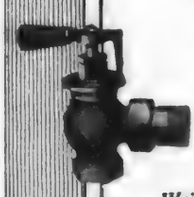

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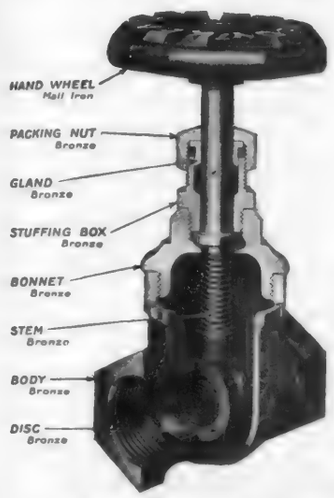

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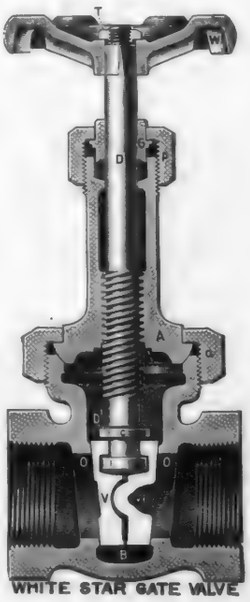

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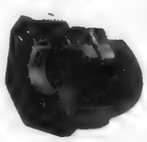

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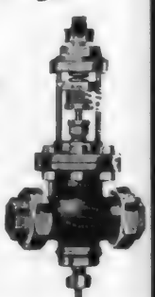

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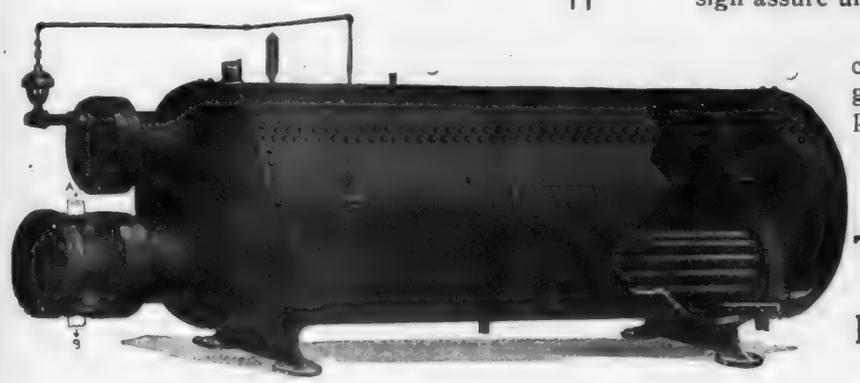

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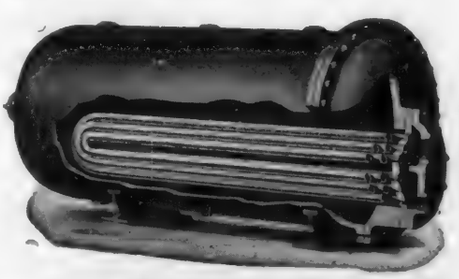

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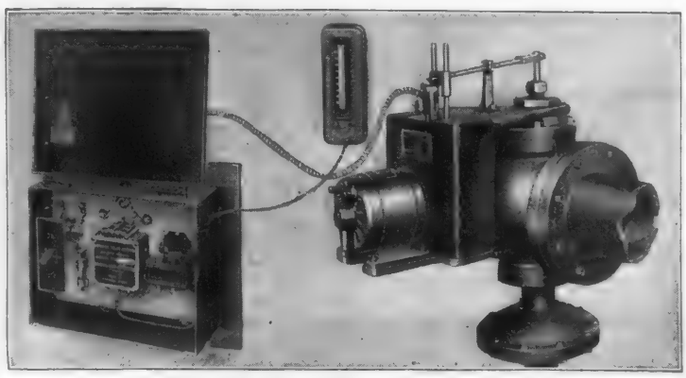
—H. A. Woodworth

(3014)

"To reach the most practical conclusions as to economy gained by automatic pressure temperature control, the writer made a series of tests, and the results showed savings of from 35% to 60%."



Hornung's "Master Control" Valve

" 'Master Control' does not interfere with individual control of rooms or radiators. It means that radiation can and should be cut off 65% of the time when the outside temperature is 40°, the average temperature of our heating season. It means that the central station and the customer will benefit equally by controlling the heat down to actual requirements."

"The writer recommends that all heating companies stress the automatic temperature control, and thereby slow down the customers' meters at night and on mild days. The waste heat which they are selling to a dissatisfied customer at their lowest rate, could be sold to a new customer at a higher rate, thereby making two satisfied customers."

" 'Master Control' is particularly well adapted to Central Station heating, as it requires no attention at any time, being electrically controlled. Many of the central heating companies throughout the country are using this type of control, and recommending it to their customers. The cost of maintenance is negligible."

Central Heat Appliances *J. C. HORNUNG Engineer* **343 S. Dearborn St., Chicago**

HERE IS A BOILER

That Burns Soft Coal—Lignite

SMOKELESS—SOOTLESS

Wayne Cross Draft Magazine Feed Boiler

EASY TO CLEAN
EASY TO CARE FOR

44 Inch Water Line

Some good territory open

Send for Catalog

WAYNE HEATER CORPORATION
Richmond, Indiana

SHUR-TITE

—The Economical—

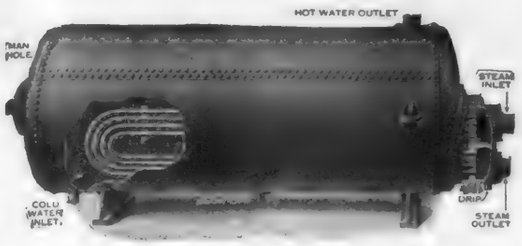
BOILER CEMENT

Reg. U. S. Patent Office

POSITIVELY GUARANTEED to seal leaks in Boiler and Radiator Sections. Just the thing to use on new heating installations before tests are made, because SHUR-TITE BOILER CEMENT will find and quickly seal all leaks that occur in new heating jobs.

Any jobber can supply you, or write us for liberal trade discounts.

The Shur-Tite Mfg. Co.
1912 Cleneay Ave., Norwood, Ohio



Patterson Combined Hot Water Service and Storage Heater—Type B.

Ready for Sudden Heavy Demands

This heater is adaptable to:

Clubs
Hotels
Apartment Houses
Association Buildings
Institutions
Bleacheries
Dye Houses
Canning Plants
Laundries
Paper and Pulp Mills
Textile Plants
Industrial Plants, etc.

Where the demands for hot water are not constant or where a large volume of water must be held in storage for sudden, heavy demands, the Patterson Combined Hot Water Service and Storage Heater fills the requirements. It operates with either live or exhaust steam—high or low pressure—automatically controlled, or in connection with low pressure, vacuum or vapor heating systems.

Our Engineering Service is offered without obligation, and the requirements of each installation are considered carefully before making recommendation as to type or capacity of the heater to be used.

Where installations are made in accordance with our recommendations, we positively guarantee satisfactory hot water service.

Patterson-Kelley Co.,

Water Heating Engineers

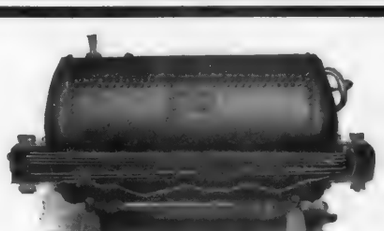
107 E. 40th St. New York

CENTRAL STATION STEAM CO.

2912 East Woodbridge St.
DETROIT, MICHIGAN

MANUFACTURERS OF
Cadillac Condensation Meters
Detroit Feed Water Meters

Packingless Expansion Joints and other special fittings for underground steam distribution mains.

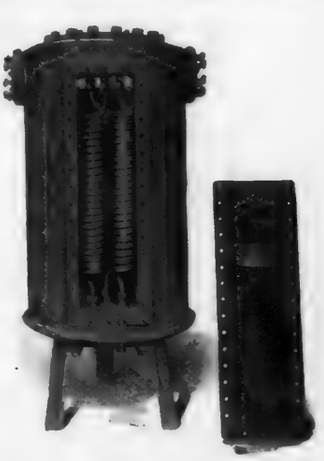


Alberger-Buffalo Storage Heaters have tubes the full length of tank which insures maximum heat transfer. Satisfaction guaranteed. Write for information on Alberger Multi Head Heaters and Howard Guided Expansion Joints.

ALBERGER HEATER COMPANY
HOWARD IRON WORKS
281-289 Chicago St. Buffalo, N. Y.

Hot Water Instantly!

Maximum Heat Transfer
Minimum Trouble



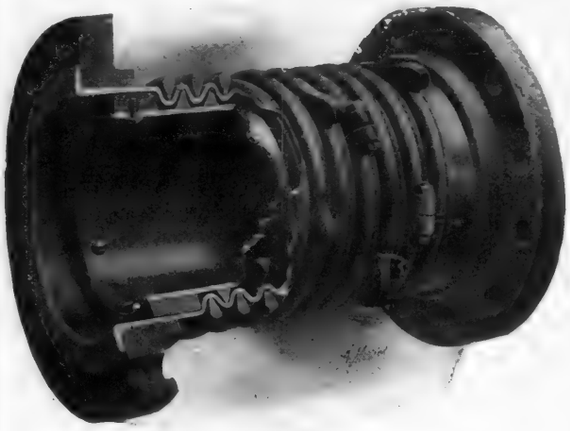
REILLY HEATER

Send for Bulletin No. 260

THE GRISCOM-RUSSELL COMPANY
2155 West Street Building
NEW YORK

WAINWRIGHT EXPANSION JOINTS ARE FLEXIBLE

SPECIFY THEM FOR YOUR NEXT INSTALLATION



Wainwright Improved Expansion Joint

MULTI-CORRUGATIONS, in a copper cylinder of even thickness, the copper being as thin as practicable for the purpose, has been shown by experience to give the greatest flexibility and longest life, due to small movement absorbed by each corrugation.

Made in two general types for low pressure small movement and high pressure long movement installations, with special designs to suit customer's individual requirements, for steam, water, gas, oil, etc.

High grade materials, expert workmanship and careful inspection insure uniform results.

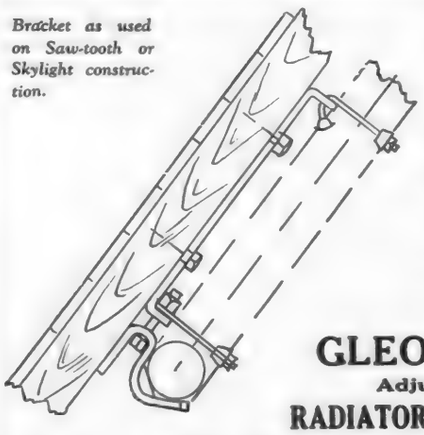
Bulletin on request.

WHEELER CONDENSER & ENGINEERING CO.

149 Broadway, New York

Works - CARTERET, N.J., NEWBURGH, N.Y.

Bracket as used on Saw-tooth or Skylight construction.



No. 2 for Horizontal Wall Radiators.

GLEOCKLE
Adjustable
RADIATOR BRACKETS

Patented

hang radiators in any position. They are easily erected, and being adjustable make the process of hanging radiators exceptionally easy.

Used in buildings where the best equipment is specified, and are preferred because they are also strong, inexpensive, sanitary and invisible after erection.

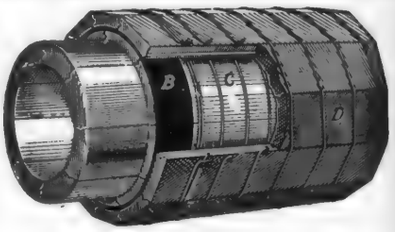
And will fit any make of wall radiator.

Let us send you descriptive booklet and trade discounts.

A. F. GLEOCKLE, Jr.

415 Bay Street ROCHESTER, N. Y

Wyckoff's Improved Cypress Covering



Lasts as Long as The Pipe Itself

As well as being highly efficient in its application, Wyckoff Improved Cypress Steam Pipe Covering withstands all conditions attending steam pipe trenches. All engineers who know Wyckoff Pipe covering specify it because it lasts.

A. WYCKOFF & SON CO. ELMIRA, N. Y.

ROSS Crosshead-GUIDED Expansion Joint Excels in

Design, Construction and Workmanship
Over 60% of sales—Repeat Orders
Once Used—Always Demanded
Every Purchaser—A Customer

ROSS HEATER & MFG. CO., INC., BUFFALO, N. Y.

New York, Chicago, Philadelphia, Boston, Cleveland, St. Louis, Detroit, Pittsburgh, Baltimore, San Francisco, Seattle, Denver, Salt Lake City, Omaha, Montreal, Toronto.

Among the Users of RIC-WIL Are:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Procter & Gamble Co., Cincinnati, O.
Fisher Body Corp'n., Detroit, Mich.
Hayes Wheel Co., Jackson, Mich.
Public Service Co. of Illinois, Chicago, Ill.
Municipal Heating Plant, Hibbing, Minn.
Wesley Memorial Hospital, Atlanta, Ga.
Alabama Girls' Technical Institute, Montevallo, Ala

A Niagara Falls, N. Y., installation of Ric-wiL Type F. Note the narrow, shallow trench.

In Any Kind of Ground

THERE are ideal conditions of ground and climate in which practically any kind of underground conduit is efficient. But such conditions are rare.

It is when ground and climate conditions are cold and wet that none except the very finest scientific conduit is actually worth putting in.

Ric-wiL has proved, again and again, that by its materials, structure and drainage, it produces the highest efficiency obtainable under any set of conditions.

In behalf of your clients, we ask you for an opportunity of demonstrating this fact. Will you write to us.

IMPORTANT!
The Ric-wiL Condensed Table of 1924-25 Heating Rates is ready. Send for your copy.

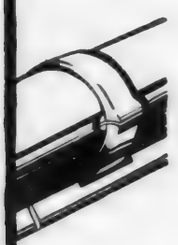
RIC-WIL Underground Conduit is made of vitrified tile, indestructible in any soil.

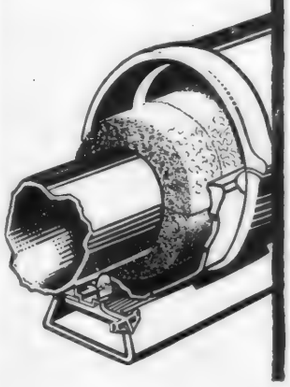
Because of its compact interlocking construction, with its base drain an integral part, it is far stronger than ordinary tile conduit.

Its drainage is thoroughly efficient, the base drain being immediately under, to draw off all moisture at once.

Even in swampy ground it keeps the insulation dry, allowing it to work at its greatest efficiency.

Its economy—both in first cost and permanent service—is easily shown.





THE RIC-WIL COMPANY, CLEVELAND, OHIO

RIC-WIL UNDERGROUND CONDUIT

ENGINEERS' SPECIFICATION INDEX

AIR COMPRESSORS.

Nash Engineering Co., So. Norwalk, Conn.

AIR CONDITIONING APPARATUS.

Air Conditioning & Engineering Co., St. Louis, Mo.
American Blower Co., Detroit, Mich.
Atmospheric Conditioning Corporation, Philadelphia, Pa.
Bayley Mfg. Co., Milwaukee, Wis.
Buckeye Blower Co., Columbus, O.
Carrier Air Conditioning Co., of America, Buffalo, N. Y.
Carrier Engineering Corporation, Newark, N. J.
Clarage Fan Co., Kalamazoo, Mich.
Fleisher Co., Inc., W. L. New York.
Ilg Electric Ventilating Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
Midwest Air Filters, Inc., New York.
New York Blower Co., Chicago, Ill.
Reed Air Filter Co., Inc., Louisville, Ky.
Sturtevant Co., B. F., Hyde Park, Mass.
L. J. Wing Mfg. Co., New York.

AIR COOLING AND DRYING SYSTEMS.

Aerofin Corp., Newark, N. J.
Atmospheric Conditioning Corp., Phila., Pa.
Bayley Mfg. Co., Milwaukee, Wis.
Buckeye Blower Co., Columbus, O.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corporation, Newark, N. J.
Clarage Fan Co., Kalamazoo, Mich.
Cooling Tower, Inc., New York.
Fleisher Co., Inc., W. L. New York.
Hersh Bros. Co., Allentown, Pa.
Ilg Electric Ventilating Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
Midwest Air Fifters, Inc., New York.
New York Blower Co., Chicago, Ill.
Skinner Bros. Mfg. Co., St. Louis, Mo.
Sturtevant Co., B. F., Hyde Park, Mass.
L. J. Wing Mfg. Co., New York.

AIR ELIMINATORS.

Jas. P. Marsh & Co., Chicago, Ill.
O-E Specialty Mfg. Co., Milwaukee, Wis.
Midwest Air Filters, Inc., New York.

AIR FILTERS.

Midwest Air Filters, Inc., New York.
Reed Air Filter Co., Inc., Louisville, Ky.

AIR SEPARATORS.

Griscom-Russell Co., New York.
Hoffman Specialty Co., New York.

AIR WASHERS.

American Blower Co., Detroit, Mich.
Atmospheric Conditioning Corp., Phila., Pa.
Badger & Sons Co., E. B., Boston, Mass.
Bayley Mfg. Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corp., Newark, N. J.
Clarage Fan Co., Kalamazoo, Mich.
Cooling Tower Co., Inc., New York.
Fleisher Co., Inc., W. L. New York.
Hersh Bros. Co., Allentown, Pa.
Ilg Electric Ventilating Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Reed Air Filter Co., Inc., Louisville, Ky.
Sturtevant Co., B. F., Hyde Park, Mass.

BLOWERS.

Fan.

American Blower Co., Detroit, Mich.
Autovent Fan & Blower Co., Chicago, Ill.
Bayley Mfg. Co., Milwaukee, Wis.
Buckeye Blower Co., Columbus, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Clarage Fan Co., Kalamazoo, Mich.
Hersh Bros. Co., Allentown, Pa.
Ilg Electric Ventilating Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Skinner Bros. Mfg. Co., St. Louis, Mo.
Sturtevant Co., B. F., Hyde Park, Mass.
L. J. Wing Mfg. Co., New York.
Yarwood Blower Wks., Niagara Falls, N. Y.

Pressure.

American Blower Co., Detroit, Mich.
Autovent Fan & Blower Co., Chicago, Ill.
Buffalo Forge Co., Buffalo, N. Y.
Clarage Fan Co., Kalamazoo, Mich.
Hersh Bros. Co., Allentown, Pa.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.
L. J. Wing Mfg. Co., New York.

Rotary.

Sturtevant Co., B. F., Hyde Park, Mass.
L. J. Wing Mfg. Co., New York.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Turbine.

Sturtevant Co., B. F., Hyde Park, Mass.
L. J. Wing Mfg. Co., New York.

BOILER CEMENT.

Johns-Manville, Inc., New York.
Shor-Tite Mfg. Co., Norwood, Cincinnati, O.

BOILERS.

Down-Draft.

American Radiator Co., Chicago, Ill.
Brownell Co., The, Dayton, O.
General Boilers Co., Waukegan, Ill.
Hart and Crouse, Utica, N. Y.
Illinois Malleable Iron Co., Chicago, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Molby Boiler Co., New York.
Oil City Boiler Works, Oil City, Pa.
Page Boiler Co., Wm. H., New York.
Pierce, Butler & Pierce Mfg. Co., New York.
Richmond Radiator Co., New York.

Heating.

American Radiator Co., Chicago, Ill.
Brownell Co., The, Dayton, O.
Bryant Heater & Mfg. Co., Cleveland, Ohio.
Continental Heater Corp., Dunkirk, N. Y.
Cox Stove Co., Abram, Philadelphia, Pa.
General Boilers Co., Waukegan, Ill.
Gorton & Lidgerwood Co., New York.
Gurney Heater Mfg. Co., Boston, Mass.
Heggie Simplex Boiler Co., Joliet, Ill.
Illinois Malleable Iron Co., Chicago, Ill.
International Heater Co., Utica, N. Y.
Kewanee Boiler Co., Kewanee, Ill.
Molby Boiler Co., New York.
Newport Boiler Co., Chicago, Ill.
Oil City Boiler Works, Oil City, Pa.
Page Boiler Co., Wm. H., New York.
Pierce, Butler & Pierce Mfg. Co., New York.
Richmond Radiator Co., New York.
Ross Boiler Co., Chicago, Ill.
Thatcher Furnace Co., Newark, N. J.
Titusville Iron Works, Titusville, Pa.
Utica Heater Co., Utica, N. Y.
Wayne Heater Corp, Richmond, Ind.
Weil-McLain Co., Chicago, Ill.

Power.

Heggie Simplex Boiler Co., Joliet, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Oil City Boiler Works, Oil City, Pa.
Ross Boiler Co., Chicago, Ill.
Titusville Iron Works Co., Titusville, Pa.

CALORIMETERS.

American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
Sarco Co., New York.

COILS, PIPE.

American Blower Co., Detroit, Mich.
Bayley Mfg. Co., Milwaukee, Wis.
Buckeye Blower Co., Columbus, O.
Buffalo Forge Co., Buffalo, N. Y.
Simmons Co., John, New York.

Air.

New York Blower Co., Chicago, Ill.

CONDENSERS.

Alberger Heater Co., Buffalo, N. Y.
American Radiator Co., Chicago, Ill.
American Steam Pump Co., Battle Creek, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Elliott Co., Jeanette, Pa.
Griscom-Russell Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Wheeler Condenser & Engineering Co., Carteret, N. J.
Whitlock Coil Pipe Co., Hartford, Conn.

CONVERTERS, HOT WATER.

Alberger Heater Co., Buffalo, N. Y.
Griscom-Russell Co., New York.
Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co. Inc., Buffalo, N. Y.
Whitlock Coil Pipe Co., Hartford, Conn.
Wyckoff & Son Co., A., Elmira, N. Y.

COOLERS.

Oil.

Alberger Heater Co., Buffalo, N. Y.
Griscom-Russell Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Whitlock Coil Pipe Co., Hartford, Conn.

COOLING TOWERS.

Badger & Sons Co., E. B., Boston, Mass.
Cooling Tower Co., Inc., New York.

COPPER BOILERS

Dahlquist Mfg. Co., Boston, Mass.

COPPER KETTLES

Dahlquist Mfg. Co., Boston, Mass.

COVERING, PIPE.

American District Steam Co., No. Tonawanda, N. Y.
Hornung, J. C., Chicago, Ill.
Johns-Manville Inc., New York.
Ric-Wil Co., Cleveland, O.
Wyckoff & Son Co., A., Elmira, N. Y.

DAMPERS, DUCT.

American Blower Co., Detroit, Mich.
Buckeye Blower Co., Columbus, O.

DEHUMIDIFYING APPARATUS.

American Blower Co., Detroit, Mich.
Atmospheric Conditioning Corp., Phila., Pa.
Bayley Mfg. Co., Milwaukee, Wis.
Carrier Engineering Corp., Newark, N. J.
Cooling Tower Co., Inc., New York.
Fleisher Co., Inc., W. L., New York.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

DISTILLERS, (Water).

Badger & Sons Co., E. B., Boston, Mass.
Griscom-Russell Co., New York.
Ross Heater & Mfg. Co. Inc., Buffalo, N. Y.

DRAFT APPLIANCES.

Combustion Specialties, New York.
Crown Fuel Saver Co., Richmond, Ind.
Simmons Co., John, New York.
Wolff Coal Saver Co., Chicago, Ill.

DRYING SYSTEMS.

(See Air Cooling and Drying Systems.)

DUST COLLECTING SYSTEMS.

American Blower Co., Detroit, Mich.
Bayley Mfg. Co., Milwaukee, Wis.
Buckeye Blower Co., Columbus, O.
Buffalo Forge Co., Buffalo, New York.
Clarage Fan Co., Kalamazoo, Mich.
Hersh Brothers Co., Allentown, Pa.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Skinner Bros. Mfg. Co., St. Louis, Mo.
Sturtevant Co., B. F., Hyde Park, Mass.

DUST COLLECTORS.

American Blower Co., Detroit, Mich.
Atmospheric Conditioning Corp., Phila., Pa.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Co., Newark, N. J.
Clarage Fan Co., Kalamazoo, Mich.
Hersh Brothers Co., Allentown, Pa.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Skinner Bros. Mfg. Co., St. Louis, Mo.
Sturtevant Co., B. F., Hyde Park, Mass.

DUST DETERMINATORS.

Atmospheric Conditioning Corp., Phila., Pa.
Hill, E. Vernon Co., Chicago, Ill.

ENGINES.

Steam, Automatic.

American Blower Co., Detroit, Mich.
Brownell Co., The, Dayton, O.
Clarage Fan Co., Kalamazoo, Mich.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Steam, High Speed.

American Blower Co., Detroit, Mich.
Brownell Co., The, Dayton, O.
Clarage Fan Co., Kalamazoo, Mich.
New York Blower Co., Chicago, Ill.
Pierce, Butler & Pierce Mfg. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

EQUALIZING LOOPS.

Hoffman Specialty Co., New York.

EVAPORATORS.

Boiler Feed Make-Up.

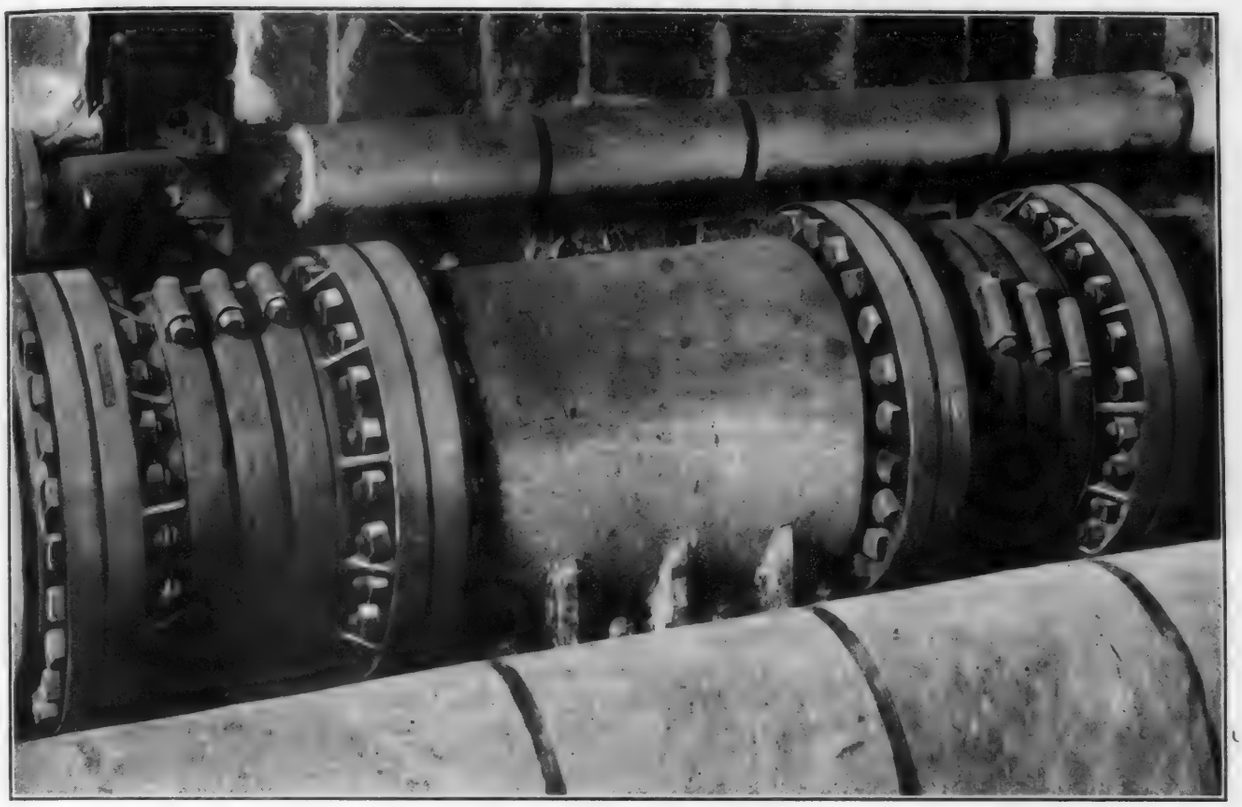
Badger & Sons Co., E. B., Boston, Mass.
Griscom-Russell Co., New York.
Ross Heater & Mfg. Co., Inc. Buffalo, N. Y.
Whitlock Coil Pipe Co., Hartford, Conn.

EXHAUST SYSTEMS.

American Blower Co., Detroit, Mich.
Bayley Mfg. Co., Milwaukee, Wis.
Buckeye Blower Co., Columbus, O.
Buffalo Forge Co., Buffalo, N. Y.
Ilg Electric Ventilating Co., Chicago, Ill.
Skinner Bros. Mfg. Co., St. Louis, Mo.
Sturtevant Co., B. F., Hyde Park, Mass.
Wing Mfg. Co., L. J., New York.

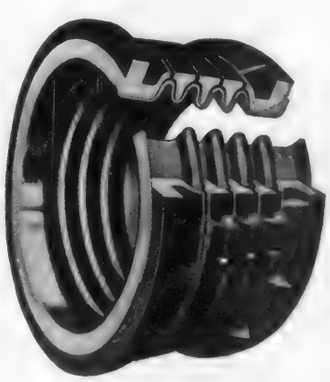
EXHAUST HEADS.

Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Patterson-Kelley Co., New York.
Simmons Co., John, New York.
Skinner Bros. Mfg. Co., St. Louis, Mo.
Sturtevant Co., B. F., Hyde Park, Mass.
Wright-Austin Co., Detroit, Mich.



Compactness—

Corrugation in the one piece, seamless copper expansion element are formed—giving uniform thickness and avoiding weak spots. Exhaustive tests have shown corrugations to be of proper depth.



Among the many advantages afforded by BADGER SELF-EQUALIZING EXPANSION JOINTS, and a big factor in their success, is COMPACTNESS.

BADGER EXPANSION JOINTS are scarcely any larger than the pipe line itself and can be bolted in place as easily as any flanged fitting. This means a big saving in excavating costs because there is no extra room needed around the joint itself, and where two or more pipes are run in one trench they can be laid close together, saving room along the entire length of the trench.

BADGER EXPANSION JOINTS, once in place, need no further attention. They are a one-piece joint, have no complicated parts and require no packing.

The seamless, one-piece, copper expansion element is corrugated and prepared in such a way as to enable it to withstand repeated expansion and compression. The iron rings equalize the strain and at the same time add strength to the copper.

Let our engineers tell you more about BADGER SELF-EQUALIZING EXPANSION JOINTS.

E.B. BADGER & SONS COMPANY

75 PITTS STREET, BOSTON, U.S.A.

Branch Offices in Principal Cities

BADGER QUALITY

ENGINEERS' SPECIFICATION INDEX (Continued)

EXPANSION JOINTS.
American District Steam Co., No. Tonawanda, N. Y.
Badger & Sons Co., E. B., Boston, Mass.
Central Station Steam Co., Detroit, Mich.
Crane Co., Chicago, Ill.
Dahlquist Mfg. Co., Boston, Mass.
Griscom-Russell Co., New York.
Hornung, J. C., Chicago, Ill.
Howard Iron Works, Buffalo, N. Y.
Illinois Engineering Co., Chicago, Ill.
Ric-Wil Co., Cleveland, O.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Webster & Co., Warren, Camden, N. J.
Wheeler Condenser & Engineering Co., Carteret, N. J.

FANS, EXHAUST.
American Blower Co., Detroit, Mich.
Autovent Fan & Blower Co., Chicago, Ill.
Bayley Mfg. Co., Milwaukee, Wis.
Buckeye Blower Co., Columbus, O.
Buffalo Forge Co., Buffalo, N. Y.
Clarage Fan Co., Kalamazoo, Mich.
Hersh Bros. Co., Allentown, Pa.
Ilg Electric Ventilating Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Skinner Bros. Mfg. Co., St. Louis, Mo.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
L. J. Wing Mfg. Co., New York.

FILTERS, (Aerating).
Cochrane Corp., Philadelphia, Pa.
Griscom-Russell Co., New York.

Feed-Water.
Elliott Co., Jeanette, Pa.
Griscom-Russell Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.

FITTINGS, FLANGED.
American District Steam Co., No. Tonawanda, N. Y.
Clow & Sons, Jas. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Simmons Co., John, New York.

FLANGES.
American District Steam Co., No. Tonawanda, N. Y.
Crane Co., Chicago, Ill.
Jenkins Bros., New York.

FLOOR SLEEVES.
Delbrook Ventilating Co., Boston, Mass.
Farley Sleeve & Hanger Co., Cleveland, Ohio.

GASKETS, METALLIC.
Sarco Co., New York.

GAUGE BOARDS.
American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
Bishop & Babcock Co., Cleveland, Ohio.
Bristol Co., Waterbury, Conn.
Foxboro Co., Inc., The Foxboro, Mass.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Taylor Instrument Cos., Rochester, N. Y.
Webster & Co., Warren, Camden, N. J.

GAUGES.

Altitude.
Pierce, Butler & Pierce Corp., New York.

Draft.
American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
Foxboro Co., Inc., The Foxboro, Mass.
Marsh & Co., Jas. P., Chicago, Ill.

Hydraulic.
American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
Foxboro Co., Inc., The Foxboro, Mass.
Marsh & Co., Jas. P., Chicago, Ill.

Ounce Graduated.
Marsh & Co., Jas. P., Chicago, Ill.
O-E Specialty Co., Milwaukee, Wis.

Pressure.
American Dist. Steam Co., North Tonawanda, N. Y.
American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
Foxboro Co., Inc., The Foxboro, Mass.
Bristol Co., Waterbury, Conn.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
O-E Specialty Mfg. Co., Milwaukee, Wis.
Webster & Co., Warren, Camden, N. J.
Bishop & Babcock Co., Cleveland, Ohio.

Vacuum.
American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
Bristol Co., Waterbury, Conn.
Foxboro Co., Inc., The Foxboro, Mass.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Taylor Instrument Cos., Rochester, N. Y.
Webster & Co., Warren, Camden, N. J.

Vacuum (Compound).
Pierce, Butler & Pierce Corp., New York.

Water.
American District Steam Co., No. Tonawanda, N. Y.
American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
Bristol Co., Waterbury, Conn.
Bristol Co., Waterbury, Conn.
Jenkins Bros., New York.

GENERATOR COOLING SYSTEMS.
Atmospheric Conditioning Corp., Phila., Pa.
Bayley Mfg. Co., Milwaukee, Wis.
Carrier Air Conditioning Co., of America, Buffalo, N. Y.
Cooling Tower Co., Inc., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

GENERATORS, (Heat.)
Honeywell Heating Specialties Co., Wabash, Ind.

GOVERNORS, (Pump).
Atlas Valve Co., Newark, N. J.
Davis Regulator Co., G. M., Chicago, Ill.
Foster Engineering Co., Newark, N. J.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Mason Regulator Co., Boston, Mass.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Wright-Austin Co., Detroit, Mich.

HEATERS.

Domestic Water.
Alberger Heater Co., Buffalo, N. Y.
American District Steam Co., No. Tonawanda, N. Y.
American Radiator Co., Chicago, Ill.
Bryant Heater & Mfg. Co., Cleveland, Ohio.
Dahlquist Mfg. Co., Boston, Mass.
Everhot Heater Co., Detroit, Mich.
Excelso Specialty Works, Buffalo, N. Y.
National Pipe Bending Co., New Haven, Conn.
Page Boiler Co., Wm. H., New York.
Patterson-Kelley Co., New York.
Pierce, Butler & Pierce Corp., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Sims Co., Erie, Pa.
Thermal Appliance Co., New York.
Whitlock Coil Pipe Co., Hartford, Conn.

Feed Water, (Closed).
Alberger Heater Co., Buffalo, N. Y.
Griscom-Russell Co., New York.
King Construction Co., North Tonawanda, N. Y.
McAlear Mfg. Co., Chicago, Ill.
Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Simmons Co., John, New York.
Sims Co., Erie, Pa.
Wheeler Condenser & Engineering Co., Carteret, N. J.
Whitlock Coil Pipe Co., Hartford, Conn.

Feed Water, (Open).
Cochrane Corp., Philadelphia, Pa.
Griscom-Russell Co., New York.
Sims Co., Erie, Pa.
Stickle Steam Specialties Co., Indianapolis, Ind.
Webster & Co., Warren, Camden, N. J.

Fuel-oil.
Alberger Heater Co., Buffalo, N. Y.
American Blower Co., Detroit, Michigan.
Griscom-Russell Co., New York.
Ross Heater & Mfg. Co., Inc. Buffalo, N. Y.
Universal Automatic Oil Burner Corporation, Detroit, Michigan.
Whitlock Coil Pipe Co., Hartford, Conn.

Air, Fan System
Aerofin Corporation, Newark, N. J.
American Blower Co., Detroit, Mich.
American Radiator Co., Chicago, Ill.
Bayley Mfg. Co., Milwaukee, Wis.
Buckeye Blower Co., Columbus, O.
Buffalo Forge Co., Buffalo, N. Y.
Clarage Fan Co., Kalamazoo, Mich.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

Portable Unit Air.
American Blower Co., Detroit, Mich.
Autovent Fan & Blower Co., Chicago, Ill.
Buffalo Forge Co., Buffalo, N. Y.
Dwyer Equipment Co., Chicago, Ill.
Ilg Electric Ventilating Co., Chicago, Ill.
Skinner Bros. Mfg. Co., St. Louis, Mo.
Sturtevant Co., B. F., Hyde Park, Mass
L. J. Wing Mfg. Co., New York.
(See also Ventilators, Portable Unit.)

HEATING SYSTEMS.

"Gasteam"
James B. Clow & Sons, Chicago, Ill.

Vacuum.
Barnes & Jones, Boston, Mass.
Bishop & Babcock Co., Cleveland, Ohio.
Dunham Co., C. A., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Klipfel Mfg. Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
O-E Specialty Co., Milwaukee, Wis.
Sarco Co., New York.
Sterling Engineering Co., Milwaukee, Wis.
Stickle Steam Specialties Co., Indianapolis, Ind.
Webster & Co., Warren, Camden, N. J.

Vapor.
American District Steam Co., No. Tonawanda, N. Y.
Barnes & Jones, Boston, Mass.
Dunham Co., C. A., Chicago, Ill.
Gold Car Heating & Lighting Co., Brooklyn, N. Y.
Gorton & Lidgerwood Co., New York.
Haines & Co., Wm. S., Philadelphia, Pa.
Ideal Heating Equip. Co., Cleveland, Ohio.
Illinois Engineering Co., Chicago, Ill.
Illinois Malleable Iron Co., Chicago, Ill
Klipfel Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Mouat Vapor Heating Co., Cleveland, O.
H. W. Nelson Co., Moline, Ill.
O-E Specialty Mfg. Co., Milwaukee, Wis.
Sarco Co., New York.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
Sterling Engineering Co., Milwaukee, Wis.
Trane & Co., La Crosse, Wis.
Vapor Heating Co., York, Pa.
Webster & Co., Warren, Camden, N. J.

Water.
Cochrane Corp., Philadelphia, Pa.

HUMIDIFIERS.
American Blower Co., Detroit, Mich.
Atmospheric Conditioning Corp., Phila., Pa.
Bayley Mfg. Co., Milwaukee, Wis.
Carrier Air Conditioning Co., of America, Buffalo, N. Y.
Carrier Engineering Corporation, Newark, N. J.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

HUMIDITY CONTROL.
American Blower Co., Detroit, Mich.
Atlas Valve Co., Newark, N. J.
Atmospheric Conditioning Corp., Phila., Pa.
Bayley Mfg. Co., Milwaukee, Wis.
Carrier Air Conditioning Co., of America, Buffalo, N. Y.
Carrier Engineering Corp., Newark, N. J.
Foxboro Co., Inc., The Foxboro, Mass.
Klipfel Mfg. Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

INSTRUMENTS.

Electric Measuring.
Bristol Co., Waterbury, Conn.
Taylor Instrument Cos., Rochester, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Indicating and Recording.
American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
Bristol Co., Waterbury, Conn.
Bailey Meter Co., Cleveland, O.
Cochrane Corp., Philadelphia, Pa.
Foxboro Co., Inc., The Foxboro, Mass.
Hill, E. Vernon Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Sarco Co., New York.
Taylor Instrument Cos., Rochester, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

INSULATING MATERIALS.
American District Steam Co., No. Tonawanda, N. Y.
Hornung, J. C., Chicago, Ill.
Johns-Manville, Inc., New York.
Ric-Wil Co., Cleveland, O.
Union Fibre Co., Winona, Minn.
Wyckoff & Sons, A., Elmira, N. Y.

MANOMETERS.
American Schaeffer & Budenberg Corp., Brooklyn, N. Y.

MECHANICAL DRAFT APPARATUS.
American Blower Co., Detroit, Mich.
Buckeye Blower Co., Columbus, O.
Clarage Fan Co., Kalamazoo, Mich.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.
L. J. Wing Co., New York.

METERS.

Condensation.
American Dist. Steam Co., No. Tonawanda, N. Y.
Central Station Steam Co., Detroit, Mich.
Hornung, J. C., Chicago, Ill.

Feed Water.
Central Station Steam Co., Detroit, Mich.
Simmons Co., John, 110 Center St., New York

Feed Water (Weir Type).
Cochrane Corp. Philadelphia, Pa.
Webster & Co. Warren, Camden, N. J.

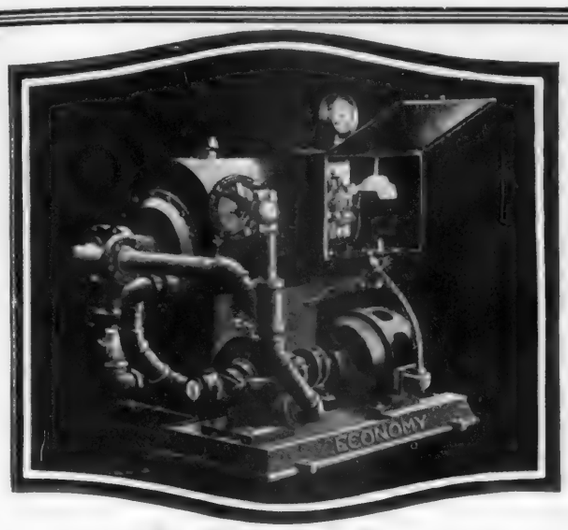


Fig. 2234. Single Pump

A Factory Kept Busy Without Display Advertising . . .

Economy Vacuum Pumps

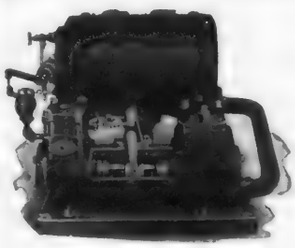
The statement above tells that each Economy Vacuum Pump has been a silent salesman for another and another, until factory facilities had to be increased. We now must tell you we want more orders to keep the new machinery humming.

Economy Centrifugal Vacuum Pumps are now often recommended by Architects and Engineers who formerly confined their specifications to one certain type and make.

Economy Pumps are conservatively rated, scientifically designed, well built of highest quality material. Standard Units discharge against 20 pounds boiler pressure: they are well powered so motors do not burn out; they use no more electric current than any other pump that will do the same work. We do not advertise skimpy motor sizes but do advertise the fact that we do not burn up motors because they are too small.

Each Pump Fully Guaranteed

ECONOMY PUMPING MACHINERY CO., 71 to 122 No. Curtis Street, Chicago

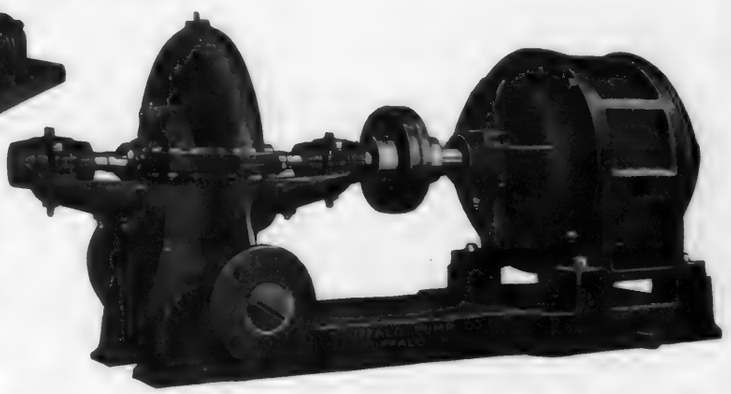


The Pumps and Receivers, the Sump Pump and the Class "S" Air Washer Pump shown are all noted for highest quality and reasonable cost.

The use of "Buffalo" Pumps on H. & V. jobs greatly increased in 1924

Sometimes quality is not found out as quickly as a noisy substitute, but once known it is adhered to for all time.

Hydraulic Balance, accessibility through divided casings, renewable clearance rings etc. are typical of Class "S" Pumps shown at right. Send for Catalog to Dept. 36.



BUFFALO STEAM PUMP COMPANY, 480 Broadway, Buffalo, N. Y.

ENGINEERS' SPECIFICATION INDEX (Continued)

METERS—(Cont'd)

Pitot Tube.

American Blower Co., Detroit, Mich.

Steam.

American District Steam Co., No. Tonawanda, N. Y.
Cochrane Corp., Philadelphia, Pa.
Foxboro Co., Inc., The Foxboro, Mass.

MOTORS (Electric).

Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

OZONE APPARATUS.

Air Conditioning & Engineering Co., St. Louis, Mo.
Ozone Pure Airifier Co., Chicago, Ill.
United States Ozone Co., Scottdale, Pa.

PIPE.

Soil.

Cast Iron.

Clow & Sons, Jas. B., Chicago, Ill.
Simmons Co., John, 110 Center St., New York.

Steel.

Simmons Co., John, 110 Center St., New York.

Wrought Iron.

National Tube Co., Pittsburgh, Pa.
Simmons Co., John, 110 Center St. New York.

Wood.

Wyckoff & Sons Co., A., Elmira, N. Y.

PIPE BENDING.

Badger & Sons Co., E. B., Boston, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Crane Co., Chicago, Ill.
National Pipe Bending Co., New Haven, Conn.
Simmons Co., John, 110 Center St., New York.
Whitlock Coil Pipe Co., Hartford, Conn.

PIPE CASING, (Wood).

American District Steam Co., No. Tonawanda. N. Y.
Wyckoff & Sons Co., A., Elmira, N. Y.

PIPE HANGERS.

Jenkins Bros., New York.
Simmons Co., John, New York.

PIPE CUTTING AND THREADING MACHINES.

Crane Co., Chicago, Ill.

PIPE, POWER.

Crane Co., Chicago, Ill.
Simmons Co., John, New York.

PUMPS.

Centrifugal.

American Steam Pump Co., Battle Creek, Mich.
Buffalo Steam Pump Co., Buffalo, N. Y.
Chicago Pump Co., Chicago, Ill.
Economy Pumping Machinery Co., Chicago, Ill.
Nash Engineering Co., So. Norwalk, Conn.
Taylor Machine Works, Battle Creek, Mich.
Westinghouse Elec. & Mfg. Co. East Pittsburgh, Pa.
Weinman Pump Mfg. Co., Columbus, Ohio.
Wheeler Condenser & Engineering Co., Carteret, N. J.
Yeomans Bros. Co., Chicago, Ill.
Young Pump Co., Michigan City, Ind.

Condensation.

American Steam Pump Co., Battle Creek, Mich.
Buffalo Steam Pump Co., Buffalo, N. Y.
Chicago Pump Co., Chicago, Ill.
Economy Pumping Machinery Co., Chicago, Ill.
Weinman Pump Mfg. Co., Columbus, Ohio.
Wright-Austin Co., Detroit, Mich.
Yeomans Bros. Co., Chicago, Ill.
Wright-Austin Co., Detroit, Mich.
Yeomans Bros. Co., Chicago, Ill.

Rotary.

Nash Engineering Co., So. Norwalk, Conn.

Steam.

American Steam Pump Co., Battle Creek, Mich.
Buffalo Steam Pump Co., Buffalo, N. Y.
Nash Engineering Co., So. Norwalk, Conn.

Turbine.

Nash Engineering Co., So. Norwalk, Conn.
Weinman Pump Mfg. Co., Columbus, Ohio.
Wheeler Condenser & Engineering Co., Carteret, N. J.
Yoemans Bros., Chicago, Ill.

Vacuum

American Steam Pump Co., Battle Creek, Mich.
Bishop & Babcock Co., Cleveland, Ohio
Chicago Pump Co., Chicago, Ill
Economy Pumping Machinery Co., Chicago, Ill.
Elliott Co., Jeanette, Pa.
McAlear Mfg. Co., Chicago, Ill
Nash Engineering Co., So. Norwalk, Conn.
Ross Heater & Mfg. Co., Inc. Buffalo, N. Y.
Skidmore Corp., Chicago, Ill.
Trane Co., La Crosse, Wis.
Weinman Pump Mfg. Co., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Yeomans Bros. Chicago, Ill.
Young Pump Co., Michigan City, Ind.

RADIATOR BUSHINGS

Metering

Holley Engineering Co., Virginia, Minn.

RADIATOR COVERS

Acme Radiator Shield Co., Cincinnati, Ohio.
Schleicher, Inc., Chicago, Ill.

RADIATOR HANGERS.

Farley Sleeve & Hanger Co., Cleveland, Ohio.
Gloeckle, Jr., A. F., Rochester, N. Y.
Healy-Ruff Co. Minneapolis, Minn.
Pierce, Butler & Pierce Mfg. Co., New York.

RADIATORS

"Gasteam"

James B. Clow & Sons, Chicago, Ill.

"Gaswater."

Clow & Sons, Jas. B., Chicago, Ill.

RADIATORS, STEAM AND WATER.

Aerofin Corp., Newark, N. J.
American Radiator Co., Chicago, Ill.
International Heater Co., Utica, N. Y.
Gurney Heater Mfg. Co., Boston, Mass.
Lyon Products Co., Chicago, Ill.
Pierce, Butler & Pierce Mfg. Co., New York.
Richmond Radiator Co., New York.
Simmons Co., John, New York.

RECEIVERS.

Air.

American District Steam Co., No. Tonawanda. N. Y.
The Brownell Co., Dayton, O.
Sterling Engineering Co., Milwaukee, Wis.

Condensation.

Chicago Pump Co., Chicago, Ill.
Davis Regulator Co., G. M., Chicago. Ill.
Economy Pumping Machinery Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Yeomans Bros., Chicago, Ill.

REGULATORS.

Boiler-Feed.

Klipfel Mfg. Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
National Regulator Co., Chicago, Ill.
Wright-Austin Co., Detroit Mich.

Damper.

American Dist. Steam Co., No. Tonawanda, N. Y.
Atlas Valve Co., Newark, N. J.
American Radiator Co., Chicago, Ill.
Bishop & Babcock Co., Cleveland, Ohio.
Davis Regulator Co., G. M., Chicago, Ill.
Honeywell Heating Specialties Co., Wabash, Ind.
McAlear Mfg. Co., Chicago, Ill.
Mueller Co., Decatur, Ill.
National Regulator Co., Chicago, Ill.
Nelson Co., H. W., Moline, Ill.
O-E Specialty Mfg. Co., Milwaukee, Wis.
Simplex Heating Specialty Co., Inc., Lynchburgh, Va.
Sterling Engineering Co., Milwaukee, Wis.
Stickle Steam Specialties Co., Indianapolis, Ind.
Trane Co., La Crosse, Wis.
L. J. Wing Mfg. Co., New York.

Pressure.

American District Steam Co., No. Tonawanda, N. Y.
Atlas Valve Co., Newark, N. J.
Crane Co., Chicago, Ill.
Davis Regulator Co., G. M., Chicago, Ill.
Foster Engineering Co., Newark, N. J.
Foxboro Co., Inc., The Foxboro, Mass.
Honeywell Heating Specialties Co., Wabash, Ind.
Hornung, J. C., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Klipfel Mfg. Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Minneapolis Heat Regulator Co., Minneapolis, Minn.
National Regulator Co., Chicago, Ill.
Stickle Steam Specialties Co., Indianapolis, Ind.
Taylor Instrument Cos., Rochester, N. Y.

Temperature.

American Radiator Co., Chicago, Ill.
Atlas Valve Co., Newark, N. J.
Bishop & Babcock Co., Cleveland, Ohio.
Carrier Engineering Corporation, Newark, N. J.
Elliott Co., Jeanette, Pa.
Foxboro Co., Inc., The Foxboro, Mass.
Fulton Co., Knoxville, Tenn.
Honeywell Heating Specialties Co., Wabash, Ind.
Hornung, J. C., Chicago, Ill.
Johnson Service Co., Milwaukee, Wis.
Klipfel Mfg. Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Minneapolis Heat Regulator Co., Minneapolis, Minn.
National Regulator Co., Chicago, Ill.
Powers Regulator Co., Chicago, Ill.
Sarco Co., New York.
Taylor Instrument Cos., Rochester, N. Y.

SEPARATORS.

Oil.

Cochrane Corp., Philadelphia, Pa.
Elliott Co., Jeanette, Pa.
Griscom-Russell Co., New York.
Illinois Engineering Co., Chicago, Ill.
Stickle Steam Specialties Co., Indianapolis, Ind.
Wright-Austin Co., Detroit, Mich.

Steam.

American District Steam Co., No. Tonawanda, N. Y.
Bishop & Babcock Co., Cleveland, Ohio.
Cochrane Corp., Philadelphia, Pa.
Crane Co., Chicago, Ill.
Elliott Co., Jeanette, Pa.
Griscom-Russell Co., New York.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Patterson-Kelley Co., New York.
Sims Co., Erie, Pa.
Stickle Steam Specialties Co., Indianapolis, Ind.
Webster & Co., Warren, Camden, N. J.
Wright-Austin Co., Detroit, Mich.

SPRAY COOLING SYSTEMS.

Atmospheric Conditioning Corp., Phila., Pa.
Bayley Mfg. Co., Milwaukee, Wis.
Cooling Tower Co., Inc., New York.
Massachusetts Blower Co., Watertown, Mass

STRAINERS.

Oil.

Elliott Co., Jeanette, Pa.
Griscom-Russell Co., New York.
Ross Heater & Mfg. Co., Inc. Buffalo, N. Y.

Steam

American Dist. Steam Co., No. Tonawanda N. Y.
Dunham Co., C. A., Chicago, Ill.
Elliott Co., Jeannette, Pa.
Foster Engineering Co., Newark, N. J.
Illinois Engineering Co., Chicago, Ill.
Kieley & Mueller, Inc., New York.
Mason Regulator Co., Boston, Mass.
McAlear Mfg. Co., Chicago, Ill.
Sarco Co., New York.
Sterling Engineering Co., Milwaukee, Wis.
Wright-Austin Co., Detroit, Mich.

Water

American Dist. Steam Co., No. Tonawanda N. Y.
Davis Regulator Co., G. M., Chicago, Ill.
Foster Engineering Co., Newark, N. J.
Illinois Engineering Co., Chicago, Ill.
Kieley & Mueller, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Mason Regulator Co., Boston, Mass.
Ross Heater & Mfg. Co., Inc., Buffalo, N. Y
Sarco Co., New York.

THERMOMETERS.

(Recording and Indicating.)

American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
Bristol Co., Waterbury, Conn.
Cochrane Corp., Philadelphia, Pa.
Foxboro Co., Inc., The Foxboro, Mass.
Moto Meter Company, Inc., Long Island City, N. Y.
Sarco Co., New York.
Taylor Instrument Cos., Rochester, N. Y.

Water

Marsh & Co., Jas. P., Chicago, Ill.
Pierce, Butler & Pierce Corp., New York.

THERMOSTATS.

American Radiator Co., Chicago, Ill.
Atlas Valve Co., Newark, N. J.
Bishop & Babcock Co., Cleveland, Ohio.
Fulton Co., Knoxville, Tenn.
Honeywell Heating Specialties Co., Wabash, Ind.
Johnson Service Co., Milwaukee, Wis
Klipfel Mfg. Co., Chicago, Ill.
Minneapolis Heat Regulator Co., Minneapolis, Minn.
Powers Regulator Co., Chicago, Ill.
Sarco Co., New York.

TRAPS.

Radiator.

Barnes & Jones, Boston, Mass.
Bishop & Babcock Co., Cleveland, Ohio.
Dole Valve Co., Chicago, Ill.
Dunham, C. A., Co., Chicago, Ill.
Hoffman Specialty Co., New York.
Ideal Heating Equipment Co., Cleveland, Ohio
Illinois Engineering Co., Chicago, Ill.
Johns-Manville, Inc., New York.
McAlear Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
Mouat Vapor Heating Co., Cleveland, O.
H. W. Nelson Co., Moline, Ill.
O-E Specialty Mfg. Co., Milwaukee, Wis.
Sarco Co., New York.
Sterling Engineering Co., Milwaukee, Wis.
Stickle Steam Specialties Co., Indianapolis, Ind.
Trane Co., La Crosse, Wis.
Webster & Co., Warren, Camden, N. J.

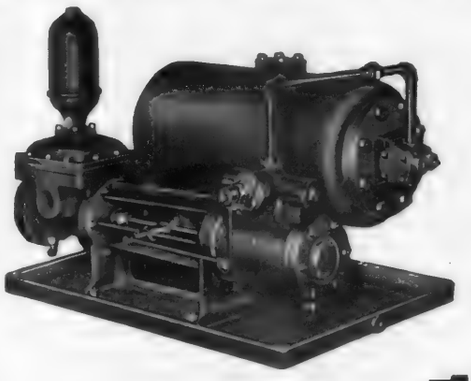
Return.

American Blower Co., Detroit, Mich.
Barnes & Jones, Boston, Mass.
Dunham Co., C. A., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Johns-Manville, Inc., New York.
Kieley & Mueller, Inc., New York.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Mouat Vapor Heating Co., Cleveland, O.
O-E Specialty Mfg. Co., Milwaukee, Wis.
Simplex Heating Specialty Co., Inc., Lynchburg, Va.
Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.
Webster & Co., Warren, Camden, N. J.
Wright-Austin Co., Detroit, Mich.

Steam.

American Blower Co., Detroit, Mich.
American District Steam Co., No. Tonawanda N. Y.
American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
Barnes & Jones, Boston, Mass.
Crane Co., Chicago, Ill.
Davis Regulator Co., G. M., Chicago, Ill.
Dunham Co., C. A., Chicago, Ill.
Elliott Co., Jeanette, Pa.
Haines & Co., Wm. S., Philadelphia, Pa.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Johns-Manville, Inc., New York.
Klipfel Mfg. Co., Chicago. Ill.

AMERICAN-MARSH CONDENSATION PUMPS



Steam and Motor Driven

The American-Marsh line of pumps for heating systems includes:

Boiler Feed Pumps

Vacuum Pumps, steam and motor driven

Hot Water Circulating Pumps

Sump or Bilge Pumps

Condensation Pumps, steam and motor driven, vertical and horizontal

Automatic Boiler Feed Pumps and Receivers

American-Marsh Pumps are the result of over 35 years experience in the building of high grade pumping machinery. There are over 165,000 in actual operation. Every pump is made with only the very best of material and workmanship and combine reliability with highest efficiency.

Ask for bulletins covering the types in which you are interested.

AMERICAN STEAM PUMP COMPANY, BATTLE CREEK, MICH.

"CHICAGO" PUMPS

Give You

HIGH QUALITY at a REASONABLE COST

"SURE RETURN" CONDENSATION PUMP
Ask for Bulletin 47.

The best workmanship and finest materials obtainable are used in building "Sure Return" Condensation and "L-1" Bilge Pumps — yet we are able to sell them at very low prices.

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ENGINEERS' SPECIFICATION INDEX (Continued)

Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Patterson-Kelley Co., New York.
Sarco Co., New York.
Simmons Co., John, New York.
Stickle Steam Specialties Co., Indianapolis, Ind.
Trane Co., La Crosse, Wis.
Wright-Austin Co., Detroit, Mich.

Vacuum.

American Blower Co., Detroit, Mich.
Bishop & Babcock Co., Cleveland, Ohio.
Dunham Co., C. A., Chicago, Ill.
Hoffman Specialty Co., New York.
Illinois Engineering Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
O-E Specialty Mfg. Co., Milwaukee, Wis.
Sarco Co., New York.
Sterling Engineering Co., Milwaukee, Wis.
Stickle Steam Specialties Co., Indianapolis, Ind.
Webster & Co., Warren, Camden, N. J.
Wright-Austin Co., Detroit, Mich.

TURBINES, (Steam).

Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
L. J. Wing Mfg. Co., New York.

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Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

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Ric-Wil Co., Cleveland, O.
Wyckoff & Son, A., Elmira, N. Y.

VACUUM CLEANING APPARATUS.

American Radiator Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Mass.

VACUUM PRODUCERS

A. & P. Regulator Co., Park Ridge, Ill.

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Air (Automatic.)

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Commonwealth Brass Corporation, Detroit, Mich.
Dole Valve Co., Chicago, Ill.
Fulton Co., Knoxville, Tenn.
Haines & Co., Wm. S., Philadelphia, Pa.
Hoffman Specialty Co., New York.
Jenkins Bros., New York.
Klipfel Mfg. Co., Chicago, Ill.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
O-E Specialty Mfg. Co., Milwaukee, Wis.
Pierce, Butler & Pierce Corp., New York.
Russell & Co., W. A., New York.
Simmons Co., John, New York.

Air Relief.

American District Steam Co., No. Tonawanda, N. Y.
American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
Barnes & Jones, Boston, Mass.
Crane Co., Chicago, Ill.
Dunham Co., C. A., Chicago, Ill.
Foster Engineering Co., Newark, N. J.
Fulton Co., Knoxville, Tenn.
Illinois Engineering Co Chicago, Ill.
Jenkins Bros., New York.
McAlear Mfg. Co., Chicago, Ill.
O-E Specialty Co., Milwaukee, Wis.
Powell Co., Wm., Cincinnati, O.
Russell & Co., W. A., New York.
Sterling Engineering Co., Milwaukee
Webster & Co., Warren, Camden, N. J

Back Pressure.

Cochrane Corp., Philadelphia, Pa.
Crane Co., Chicago, Ill.
Foster Engineering Co., Newark, N. J.
Griscom-Russell Co., New York.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Kieley & Mueller, Inc., New York.
Klipfel Mfg. Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Simmons Co., John, New York.
Stickle Steam Specialties Co., Indianapolis, Ind.

Balanced.

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McAlear Mfg. Co., Chicago, Ill.
Stickle Steam Specialties Co., Indianapolis, Ind.

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Crane Co., Chicago, Ill.
Elliott Co., Jeanette, Pa.
Jenkins Bros., New York.
The Wm. Powell Co., Cincinnati, O.
Simmons Co., John, New York.

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Jenkins Bros., New York.
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O-E Specialty Mfg. Co., Milwaukee, Wis.
Powell Co., Wm., Cincinnati, O.
Simmons Co., John, New York.

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Illinois Engineering Co., Chicago, Ill.
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Mason Regulator Co., Boston, Mass.

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Hydraulic-Operating.

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Crane Co., Chicago, Ill.
Klippel Mfg. Co., Chicago, Ill.

Non-Return.

American Schaeffer & Budenberg Corp., Brooklyn, N. Y.
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Davis Regulator Co., G. M., Chicago, Ill.
Foster Engineering Co., Newark, N. J.
Jenkins Bros., New York.
McAlear Mfg. Co., Chicago, Ill.
Powell Co., Wm., Cincinnati, O.
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Kennedy Valve Mfg. Co., Elmira, N. Y.
McAlear Mfg. Co., Chicago, Ill.
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Marsh Valve Co., Dunkirk, N. Y.
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Simmons Co., John, New York.
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Webster & Co., Warren, Camden, N. J.

Reducing.

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Atlas Valve Co., Newark, N. J.
Davis Regulator Co., G. M., Chicago, Ill
Dunham Co., C. A., Chicago, Ill.
Foster Engineering Co., Newark, N. J.
Illinois Engineering Co., Chicago, Ill.
Jenkins Bros., New York.
Johnson Service Co., Milwaukee, Wis.
Kennedy Valve Mfg. Co., Elmira, N. Y.
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Powell Co., Wm., Cincinnati, O.
Powers Regulator Co., Chicago, Ill.
Atlas Valve Co., Newark, N. J.

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McAlear Mfg. Co., Chicago, Ill.
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McAlear Mfg. Co., Chicago, Ill.
Powell Co., Wm., Cincinnati, Ohio.

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(See Valves, Non Return.)

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Peerless Unit Ventilating Co., New York.
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(See also Heaters, Portable Unit Air.)

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Atmospheric Conditioning Corp., Phila., Pa.
Autovent Fan & Blower Co., Chicago, Ill.
Bayley Mfg. Co., Milwaukee, Wis.
Buckeye Blower Co., Columbus, O.
Buffalo Forge Co., Buffalo, N. Y.
Carrier Engineering Corporation, Newark, N. J.
Clarage Fan Co., Kalamazoo, Mich.
Hersh Bros. Co., Allentown, Pa.
Ilg Electric Ventilating Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
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New York Blower Co., Chicago, Ill.
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Buckeye Blower Co., Columbus, O.
Buffalo Forge Co., Buffalo, N. Y.
Ilg Electric Ventilating Co., Chicago, Ill.
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Sturtevant Co., B. F., Hyde Park, Mass.
L. J. Wing Mfg. Co., New York.

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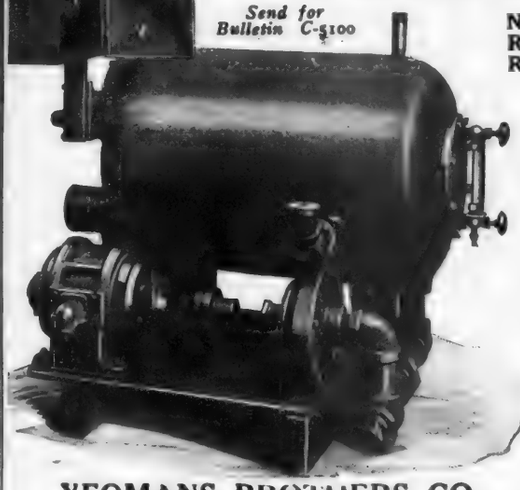

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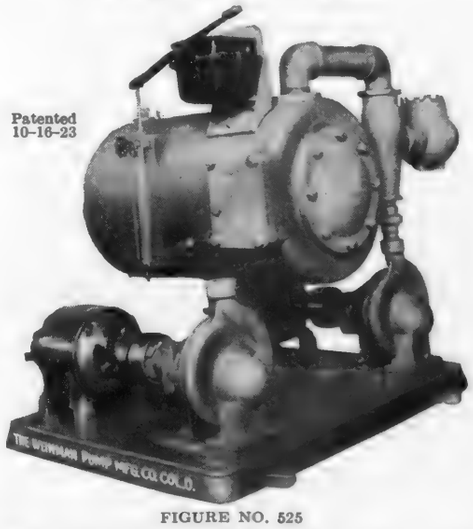

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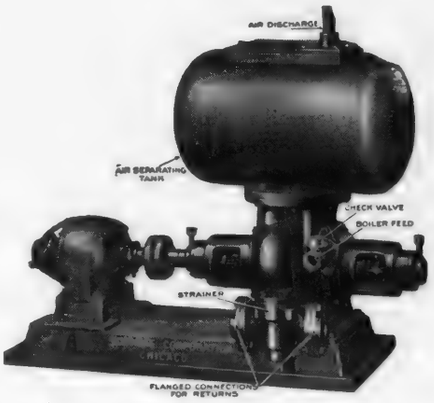

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ADVERTISERS' INDEX

Acme Radiator Shield Co. 106
A-Em-Dee Engineering Co. 114
Aerofin Corporation 102
Alberger Heater Co. 131
Allen Air-Turbine Ventilator Co. 43
American District Steam Co. 34
American Radiator Co. 7, 33
American Schaeffer & Budenberg Corp. 123
American Steam Pump Co. 139
Ames Iron Works 12
Athey Co. 112
Atlas Valve Co. 128
Atmospheric Conditioning Corp. 114
Autovent Fan & Blower Co. 99
A. & P. Regulator Co. 124

Badger & Sons Co., E. B. 135
Barnes & Jones 124
Bayley Mfg. Co. 104
Bishop & Babcock Co. 26
Bristol Co. 122
Brownell Co —
Bryant Heater & Mfg. Co. 8
Buckeye Blower Co. 117
Buffalo Forge Co. 111
Buffalo Steam Pump Co. 137

Carrier Air Conditioning Co. of America. 111
Carrier Engineering Corp. 100
Central Station Steam Co. 131
Chicago Pump Co. 139
Clarage Fan Co. 35, 36
Clow & Sons, James B. 12
Cochrane Corp. 120
Combustion Fuel Oil Burner Co. 118
Combustion Specialties Co. 114
Commonwealth Brass Corp. 30
Continental Heater Corp. 10
Crown Fuel Saver Co. 118

Dahlquist Mfg. Co. 110
Davis Regulator Co., G. M. 127
Dole Valve Co. Front Cover
Dunham Co., C. A. 25
Dwyer Equipment Co. 43

Economy Pumping Machinery Co. 137
Elliott Co. 125
Everhot Heater Co. 14
Excelso Specialty Works, Inc. 144

Farley Sleeve & Hanger Co. 42
Foxboro Co., Inc., The 126
Fulton Co. 103

General Boilers Co. 4
Gleockle, Jr., A. F. 132
Gold Car Heating & Lighting Co. 122
Gorton & Lidgerwood Co. 26
Griscom-Russell Co. 131
Gurney Heater Mfg. Co. 8

Haines & Co., Wm. S. 32
Healy-Ruff Co. 112
Heggie Simplex Boiler Co. 46
Higgin Mfg. Co. 114
Holley Engineering Co. 128
Hornung, J. C. 130

Ideal Heating Equipment Co. 124
Illinois Engineering Co. 23
Illinois Malleable Iron Co. 18
International Heater Co. 9

Jenkins Bros. 30
Johns-Manville, Inc. 101
Johnson Service Co. 48

Kennedy Valve Mfg. Co. 127
Kewanee Boiler Co. 5
Kieley & Mueller, Inc. 102
Klipfel Mfg. Co. 24
Knowles Mushroom Ventilator Co. 108

Linde Air Products Co. 105
Lyon Products Co. 112, 116

MaGirl Foundry & Furnace Wks., P. H. 109
Marsh & Co., Jas. P. 3
Marsh Valve Co. 31
Mason Regulator Co. 128
McAlear Mfg. Co. 28
Midwest Air Filters, Inc. 113
Minneapolis Heat Regulator Co. 124
Monarch Metal Products Co. 108
Moto Meter Co., Inc. 122
Mouat Vapor Heating Co. 24
Mueller Co. 107

Nash Engineering Co. 98
National Pipe Bending Co. 129
National Regulator Co. 20
National Tube Co. 19
Nelson Corp., Herman 37
Nesbitt, Inc., John J. 121
Newport Boiler Co. 6
New York Blower Co. 116
O-E Specialty Mfg. Co. 28
Oil City Boiler Works 6

Ozone Pure Airifier Co. 100

Page Boiler Co., Wm. H. 15
Patterson-Kelley Co. 131
Peerless Unit Ventilator Co. 3
Pierce, Butler & Pierce Mfg. Co. 12
Powell Co., Wm. 127
Powers Regulator Co. 38, 93

Reed Air Filter Co., Inc. 119
Richmond Radiator Co. 13
Ric-wiL Co. 103
Ross Boiler Co. 2
Ross Heater & Mfg. Co. 132
Russell & Co., W. A. 32

Sarco Co. 27
Schleicher, Inc. 16
Shur-Tite Mfg. Co. 130
Simmons Co., John 18
Simplex Heating Specialty Co. 23
Sims Co. 129
Skidmore Corp. 141
Skinner Bros. Mfg. Co. 118
Sterling Engineering Co. 20
Stickle Steam Specialties Co. 106
Sturtevant Co., B. F. 115

Taylor Instrument Cos. 128
Thatcher Furnace Co. —
Thermal Appliance Co. 125
Titusville Iron Works Co. 10
Trane Co. 29

Union Fibre Co. 142
United States Ozone Co. 120
Utica Heater Co. 11

Vapor Heating Co. 42
Want Ads 106
Wayne Heater Corp. 130
Webster & Co., Warren 22
Weil-McLein Co. 143
Weinman Pump Mfg. Co. 141
Westinghouse Elec. & Mfg. Co. 44, 45
Wheeler Condenser & Engineering Co. 132
Whitlock Coil Pipe Co. 21
Wing Mfg. Co., L. J. 108
Wolff Gas Radiator Co., A. H. 17
Wright-Austin Co. 140
Wyckoff & Son Co., A. 132
Yeomans Bros. Co. 141
Young Pump Co. 129

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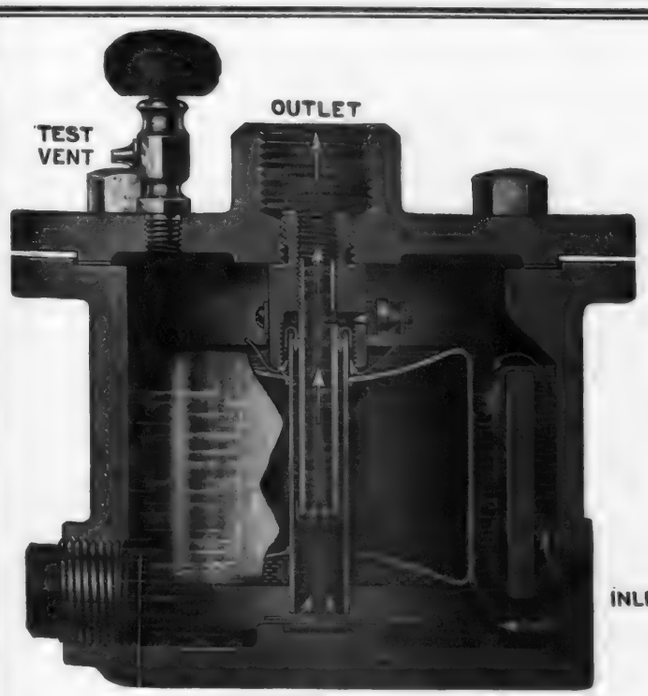

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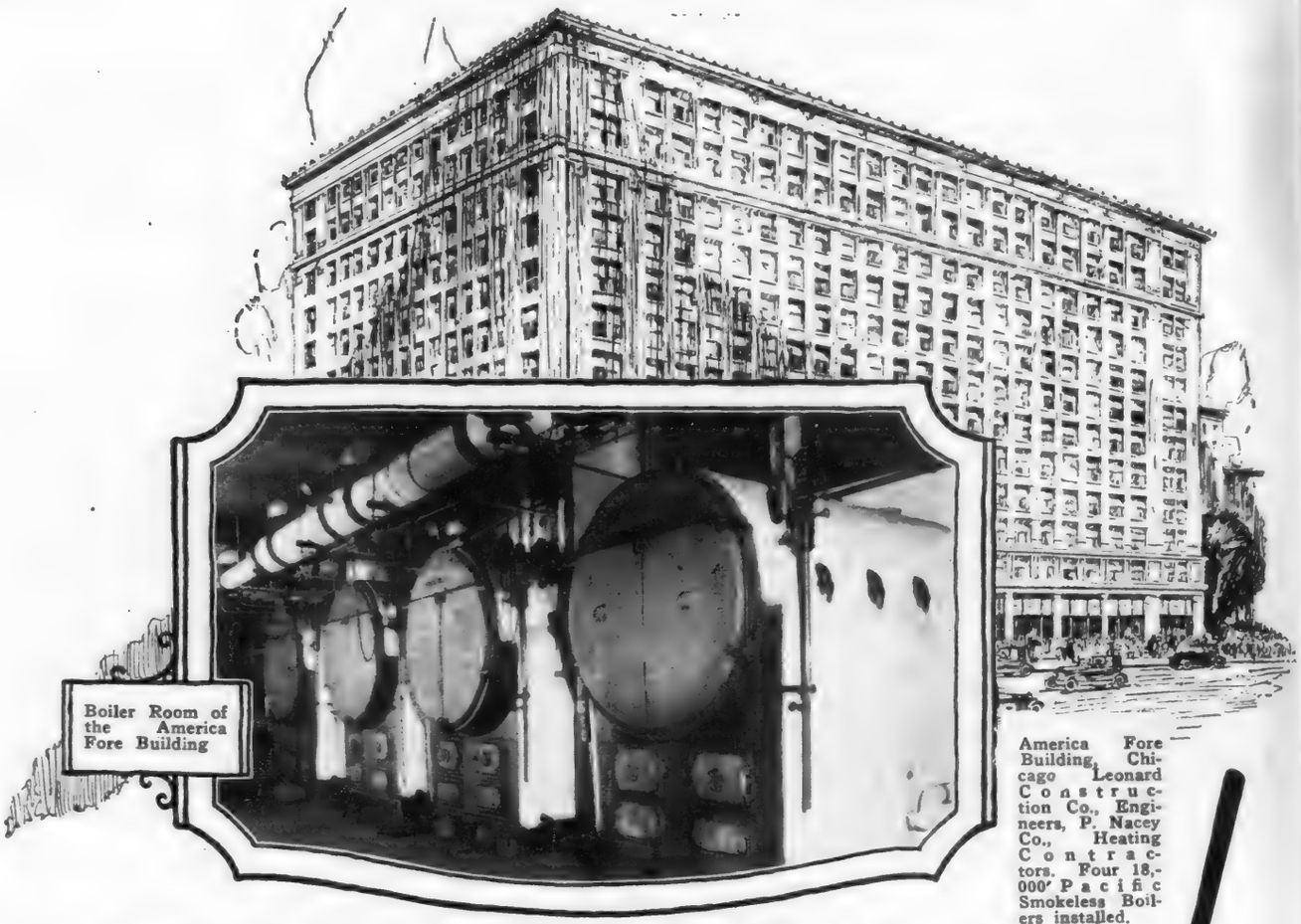

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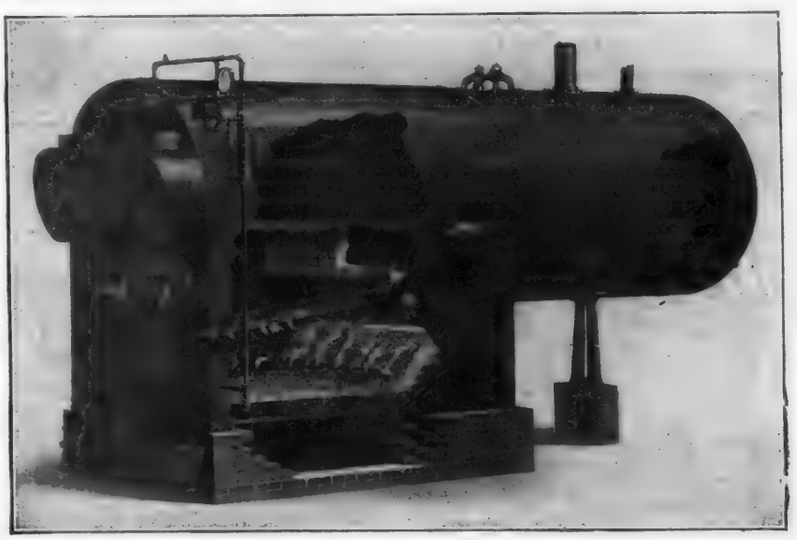

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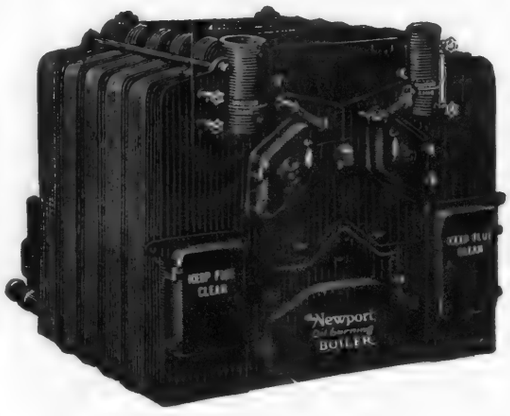
BOSTON, Little Bldg., 90 Boylston St.

Steel Heating Boilers, Radiators, Tanks, Water Heating Garbage Burners.

THE NEWPORT BOILER FOR OIL BURNING



EXPERIENCE in the use of oil burners for domestic heating has established this one law as fundamental:—*the starting point for success is in the boiler.*

It does not make any difference how perfectly the *burner* functions, the success of the installation depends on the ability of the *boiler* to absorb the heat generated.

An efficient boiler is much more necessary with oil fuel than with coal, for the following reasons:—the gases are traveling at greater velocity; heat is usually intermittent; there is comparatively little radiant heat, so that much more of the work is done in the flues. Hence, the efficient oil burning boiler will show a much greater saving in fuel over the ordinary boiler than in the case of similar boilers burning coal.

There are certain features which experience has taught engineers to demand in an oil burning boiler. These are discussed fully in Newport Oil Boiler literature which is yours for the asking.

Newport Boiler Company

105 South Dearborn Street, Chicago, U.S.A.

New York Office: 101 Park Avenue

Gurney Sectional Boilers

Steam and Water

900 Series

No. 935 STEAM BOILER
Also for Water

As a result of unusual exhaustive tests to eliminate the defects usually found in push nipple square sectional boilers, the 900 Series Boilers represents the embodiment of many advantages not found in other boilers.

Low water line meets requirements where head room is limited.

Made in four widths of grates covering a wide range of sizes, suitable for both small requirements as well as the larger class of work requiring a battery of two or more boilers.

Generous grate areas, large prime fire surfaces and unusual coal carrying capacity. Highest grade pig iron is used to produce greatest tensile strength. Steam boilers have liberal steam space.

Well arranged heating surfaces, ample flue areas, ease in cleaning, rocking and dumping type grates, all help in giving the owner economical and satisfactory service.

GURNEY HEATER M'F'G COMPANY.

General Offices:

New York 11 East 42d Street | Boston, Mass. 93-95 Oliver St., Fort Hill Square | Philadelphia 108 North 17th Street

Wolff Draft Conditioners

A fuel saving—and heat improving device that has "made good"

In the City of Chicago alone more than 5200 boilers are now equipped with Wolff Draft Conditioners. Some of them have been on the job for more than five years. In every case they have "made good" by thoroughly proving their ability to

999 Lake Shore Drive, one of Chicago's Finest
Marshall & Fox, Chicago, *Architects*
Heated with 2 Kewanee Boilers, equipped with
Wolff Draft Conditioners.

Save Fuel, whether coal or oil is used.

Help maintain constant heat, with less labor.

Reduce Ashes, by bettering combustion.

Minimize Smoke

Keep radiators warm later after banking.

They are the best friends any heating contractor ever had. Because by making it possible for any boiler to be operated at its greatest efficiency, without the employment of skilled firemen, they eliminate many of the complaints which every heating contractor is subject to.

Write us for full particulars
Every heating contractor can make money installing them.

SALES REPRESENTATIVES CALLING ON ARCHITECTS, OWNERS and CONTRACTORS

We want a good representative in every City, not now covered, to sell Wolff Draft Conditioners to Architects, Heating Contractors and Owners. Write for our Agency Plan.

Wolff Coal Saver Co.

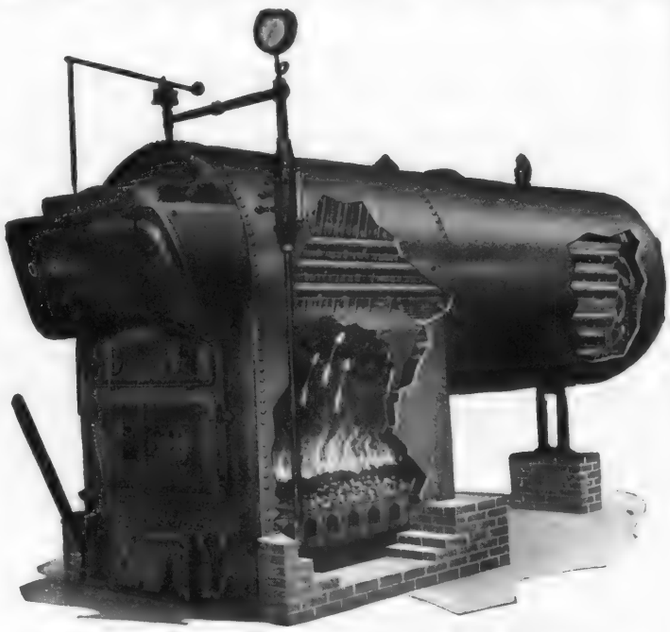
1336 West Congress St. - - Chicago

OIL CITY BOILERS

The widespread preference for Oil City Boilers by the educational institutions of the country is evidence of confidence in Oil City service.

"Safety first" then efficiency and maintenance does seem to mean "Oil City".

Catalog H-9 will be sent upon request.



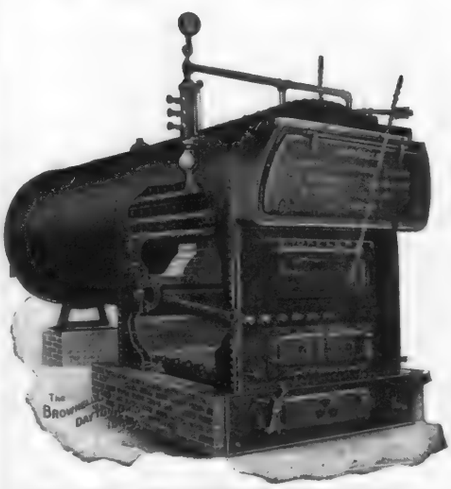
Built of Steel, in Accordance with the A. S. M. E. Code

OIL CITY BOILER WORKS, OIL CITY, PA.

NEW YORK CHICAGO PITTSBURGH ATLANTA PHILADELPHIA LOS ANGELES

STEEL BOILER

WHY



Brownell Return Flue Portable Boiler—Smokeless Type

COST: Arrives on job and installed in one piece.
No cost of assembling sections.
Low insurance cost.

EFFICIENCY: High thermal conductivity.
High tensile strength, uniform in thickness.
Generous and properly designed firebox, permitting complete combustion.
Easy access for cleaning, insuring clean heating surfaces.

MAINTENANCE: Boilers capable of standing sudden and extreme changes of temperature because of high factor of safety, and nature of material.
No long and expensive shut-downs for repairs because of waiting for new parts.

BROWNELL

Backed by 68 years of boiler experience.
Thoroughly inspected during construction and upon completion.
You take no risk in buying a Brownell Boiler.
Allow us to eliminate your heating troubles.
Sales representatives in all large cities.

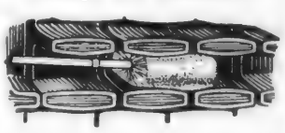
THE BROWNELL CO., DAYTON, OHIO

ESTABLISHED 1855

INTERNATIONAL ECONOMY BOILERS

What is Your Specification— Cottage or Skyscraper?

Easy to Clean



There are no overhanging water legs or soot pockets to collect soot. All surfaces are easily cleaned thru large cleanout doors placed at the front of the boiler.

Easy cleaning is just one of the many features that appeal to your customers.

REGARDLESS of the specifications you will find an INTERNATIONAL Economy of the proper size and type to meet the requirement. No job too big, none too small, for the Economy line where boilers of the cast iron low pressure type would be used.

Round horizontal sectional type for small homes, square vertical sectional type for apartments, large residences, garages, etc., and the smokeless type which handles big jobs in a simple and amazingly practical manner.

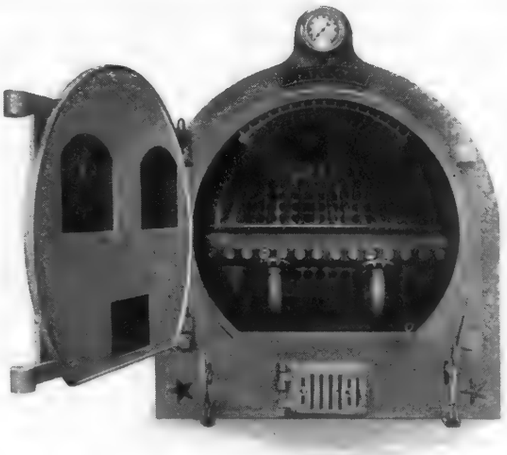
Complete information in our Handy Reference Book. Have you a copy in your files?

INTERNATIONAL HEATER CO.

UTICA, N. Y.

CHICAGO NEW YORK CLEVELAND DETROIT NASHUA, N. H.

ONLY 63 INCHES

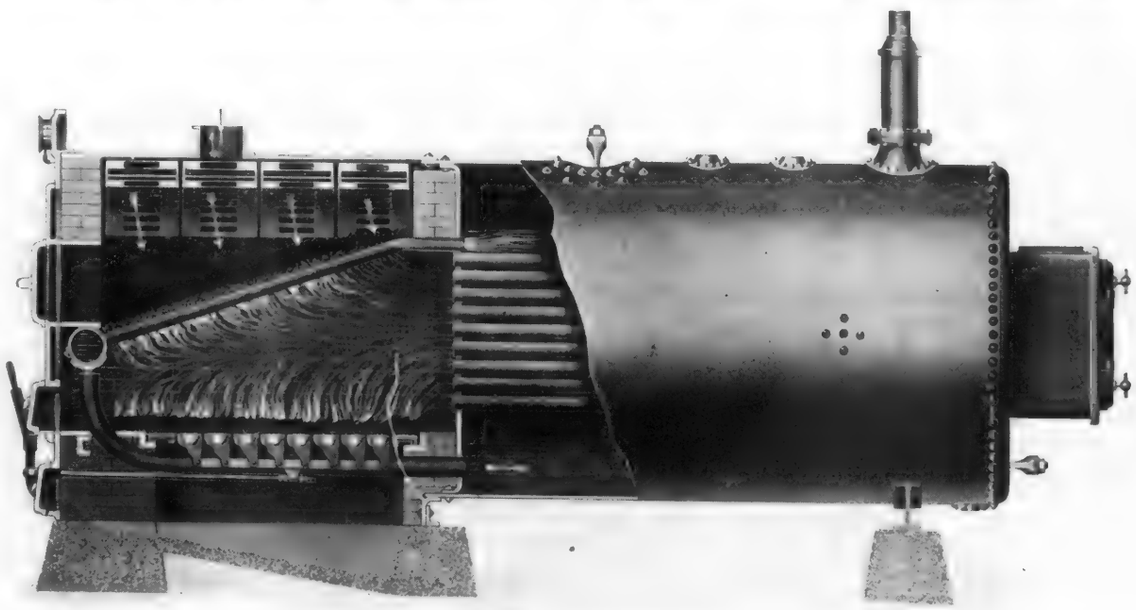


Heating Capacity
Steam: 3300 to 25,000 sq. ft.
Water: 5200 to 40,000 sq. ft.

Working Pressures
15 lbs. for Heating.
125 to 200 lbs. for Power.

Sizes 29 to 210 H. P.
Built to A. S. M. E. Code—No Superior for Safety

NO MUDLEGS—NO STAYBOLTS



Stanwood

TO WATER LINE

The water level for a 100 H. P. unit is only 63 inches—A valuable point, where headroom is limited.

Fuel economy is obtained by almost perfect combustion.

No air leaks.

Radiation losses are insignificant.

Rapid Circulation.

Low Stack Temperatures.

Shell cannot be bagged or seams cracked.

Write for Bulletins and Leaflets

Builders since 1891 of Horizontal Return Tubular, Locomotive Fire Box Portable Boilers, H. S. G. Throttling and Automatic Steam Engines, Open and Closed Feed Water Heaters.

The Stanwood Corporation

CINCINNATTI, OHIO

Stanwood Smokeless Boilers

SUCCESSOR TO
THE HOUSTON, STANWOOD & GAMBLE CO.

Installations in

Detroit
Toledo
Cleveland
Buffalo
Niagara Falls
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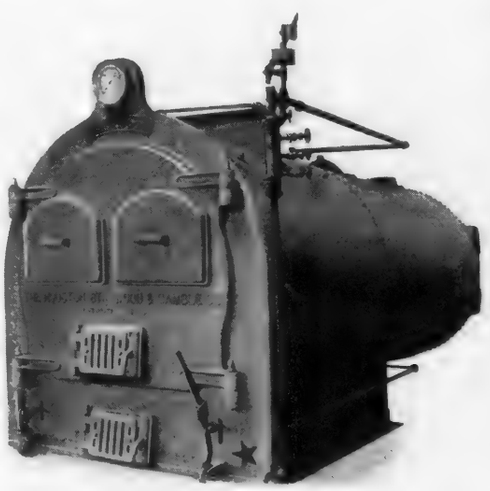
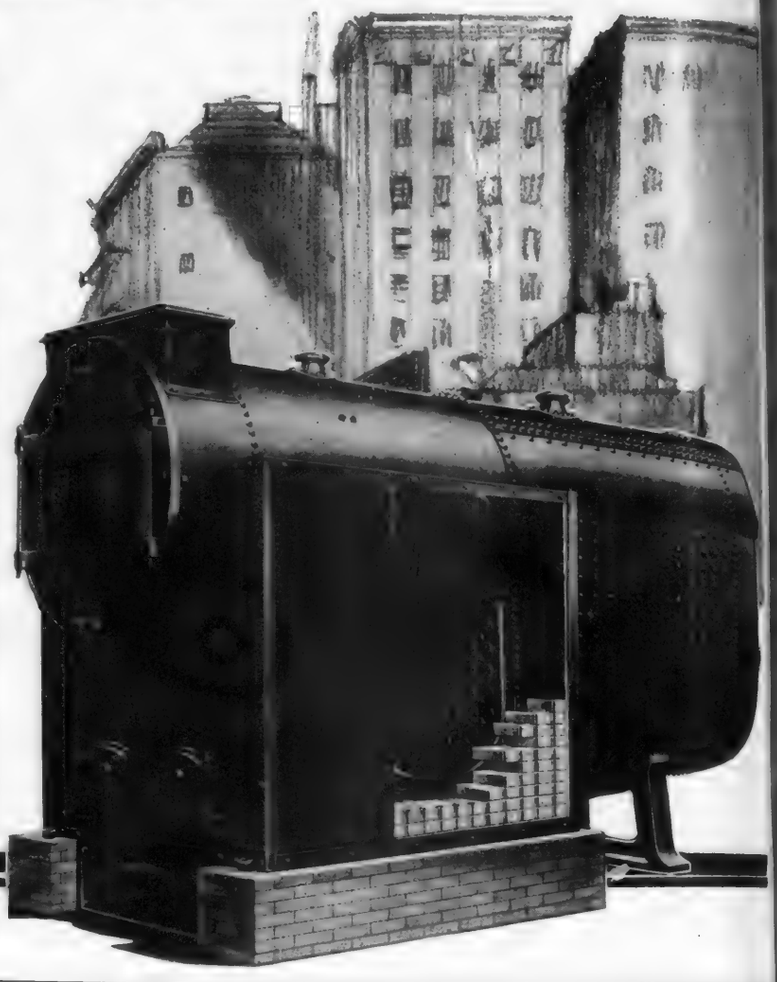
Columbus
Indianapolis
Cincinnati
and other cities.



Smokeless Boilers

For Heating and Power

Titusville PERFECTION BOILERS for POWER & HEATING



Titusville Perfection Boilers with their high brick lined firebox, steel casing and large effective heating surface, assure complete combustion of all fuels; solid liquid or gaseous, and lower fuel bills.

Built for power or steam heating, pressures 15 lbs. to 150 lbs. *Can be readily adapted for oil burning.*

Catalogue No. 81 of Titusville Boilers should be in the file of all architects and engineers.

THE TITUSVILLE IRON WORKS COMPANY

TITUSVILLE, PA.

Sales Offices:

New York, 152 W. 42nd St.
Washington, D. C., Woodward Bldg.
Detroit, Mich., Peter Smith Bldg.
Buffalo, N. Y., Marine Trust Bldg.
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DON'T BURN UP YOUR MONEY

REDUCE COAL BILLS

BY INSTALLING

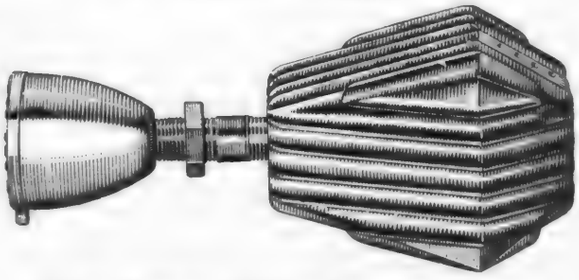
Manufacturer's Certified Ratings

Average Reductions of Coal:

10-20% on High Pressure Steam
15-40% on Low Pressure Steam
25-45% on Hot Water Heating
25-35% on Hot Air Heating

Burnrite Combustion Devices

Simple to Install
Automatic in Operation
No Upkeep Expense
No Regulation
Years of Service



Adapted to Steam Hot Water or Hot Air Plants — Industrial Plants — High Pressure

Makes Money for you and your customer.

Write, Phone or Call For Prices and Circular

JOHN SIMMONS CO

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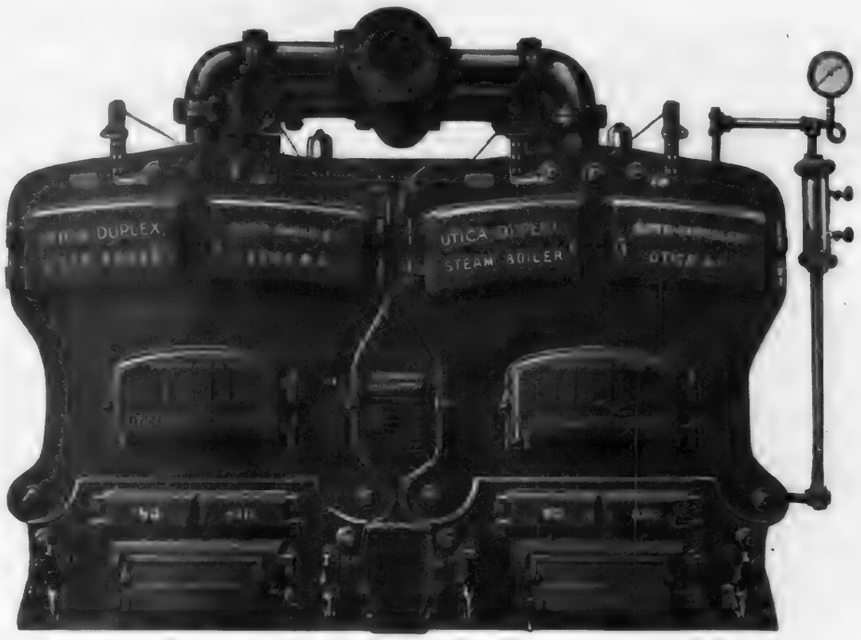
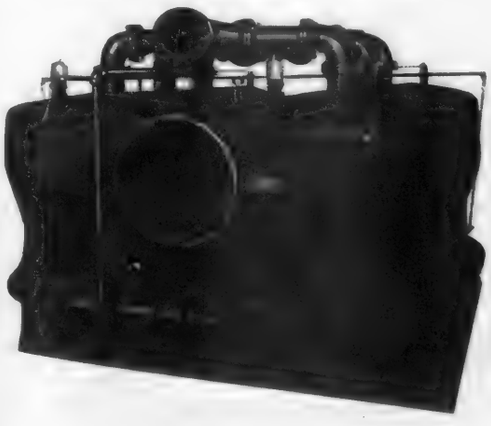


Front View of Utica-Duplex SUPER-SMOKELESS Boilers

UTICA-DUPLEX
SUPER-SMOKELESS BOILERS
Announcing the New Duplex Boiler!

UTICA-DUPLEX SUPER-SMOKELESS Boilers have many advantages over the ordinary type of wide grate boilers. A double fire-box gives a greater amount of heating surface per square foot of grate area, and this surface is in direct contact with the fire. The header construction, which is shipped as an integral part of the boiler, assures large steam space. The individual grates require less attention and make possible a greater latitude in the fire required at different seasons of the year. One half of the boiler will operate as efficiently as a single boiler, the other half neither chilling the fire nor requiring wastage of coal to cover the unused portion of the grate. It is possible to shut down one half of the boiler for cleaning the grates or any other purpose. Precautions have been taken to equalize the boilers, and a steady water line is maintained at all times. Engineers and contractors are invited to write for complete information.

Rear View of Utica-Duplex SUPER-SMOKELESS Boiler Showing Header, Equalizer, Return Connections and Air Grates through which Supplementary Air is admitted to the Boiler.



Manufactured by the

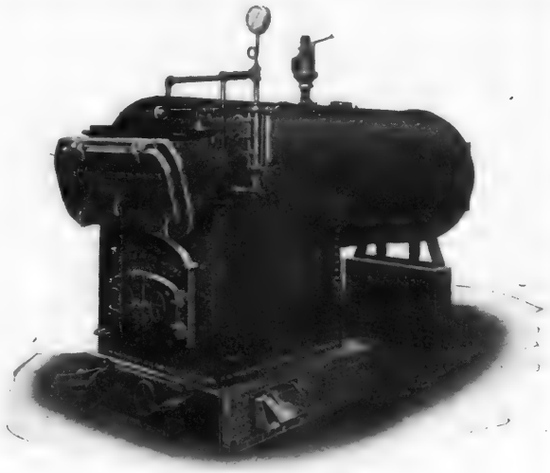
UTICA HEATER COMPANY

UTICA, N. Y.

CHICAGO CLEVELAND NEW YORK

Sales Offices in the Principal Centers

AMES
Firebox Heating Boilers



Ames Firebox Heating Boiler with Plain Furnace

Built with Plain and Downdraft Furnaces. Incorporating the Latest and Most Advanced Ideas in Boiler Design and Construction.

We also build a complete line of Horizontal Tubular, Upright and Empire Boilers for Heating and Power Requirements.

Bulletins with complete details mailed on request.

Empire Return Tubular Portable Boiler

AMES IRON WORKS
DIVISION OF
Pierce, Butler & Pierce Mfg. Corp.

Main Office & Works
Oswego, N. Y.

General Sales Office
41 E. 42nd St., New York City

While building o remodeling—instal modern heatin

STEAM HEAT AT THE TURN OF A VALVE—ON OR OFF IN A MINUTE

Clow Gasteam Radiators eliminate the central heating plant entirely. And they require no connection with water piping.

With Clow Gasteam Radiators you can turn the heat on or off instantly. Simply turn on the gas and light a match, and you have steam heat.

Automatic Regulation

Moreover, Clow Gasteam Radiators are automatically regulated to maintain an unvarying steam pressure regardless of outside temperatures.

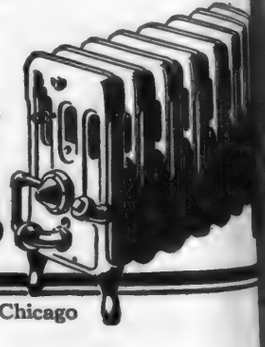
One hundred per cent of the fuel they use is converted into usable heat. You don't have to have a boiler, a coal bin, an oil tank or even a cellar to have Clow Gasteam heat.
All you need is a gas connection.

Thousands of Users

Clow Gasteam Radiators look like any other radiators, except possibly that they are more attractive in design. They are carefully built, carefully tested. They have twenty years' use back of them, and over forty years of Clow experience and reputation.

Thousands of satisfied users everywhere. We can furnish you with a list covering this vicinity. Do you not want to know more about this modern, clean, convenient and healthful method of heating? Write or call us today.

JAMES B. CLOW & SONS
534-546 So. Franklin Street
CHICAGO



CLOW "GASTEAM" HEATING SYSTEMS

Mfd. by JAMES B. CLOW & SONS, Chicago

The Monarch Smokeless Boiler

For All Fuels—Hard or Soft Coal, Gas and Oil

Smoke Is Wasted Fuel

THERE is an increasing demand for a heating boiler that will burn soft or bituminous coal *without smoke*. This demand has been brought about by the increased use of soft coal, due to the high cost or inadequate supply of hard or anthracite coal.

The emission of smoke is a sure indication of imperfect combustion, showing that the rich gases from the products of combustion are not being thoroughly consumed, escaping unburned up the chimney, as is evidenced where soft coal is burned in the ordinary boiler, it being impractical in such types to supply the rapidly liberated gases with sufficient air through the grate to ignite and consume them thoroughly, resulting in a large percentage of the fuel being wasted, going forth in form of smoke, injurious to health, the building and surroundings; and this has compelled most cities and towns to adopt rigid anti-smoke ordinances.

The Monarch Smokeless Boiler is a single grate boiler. The products of combustion rise in the fire box, coming in contact with the valuable direct overhanging fire surface, thence passing to the rear or secondary combustion chamber where air from both sides of the boiler is admitted through the air inductor over the fuel bed, producing a mixture of proper proportions for complete combustion before the gases, now fully ignited, turn and pass through the lower tier of flues to the front of the boiler and back to the chimney through the upper tier, the heat units thereby released being absorbed by the heating surfaces of the flues, and all combustibles completely consumed before leaving the boiler, absolutely eliminating all smoke, even with the cheapest grades of soft coal.

The Monarch Smokeless Boiler, not only burns any grade of soft coal smokelessly, but effects a *saving of* 25% to 33 1/3% without the skilled care and excessive attention required in other constructions.

Boiler capacities:
Steam, 1,075 sq. ft. to 15,400 sq. ft.
Water, 1,775 sq. ft. to 25,400 sq. ft.

The Monarch Smokeless Boiler, while primarily designed for burning soft coal, is also adapted for burning hard coal, coke, wood, oil or gas, with high efficiency and economy. Fuel shortages experienced in the past emphasize the advantage of this convertibility.

Monarch Smokeless Steam Boiler

THE WM. H. PAGE BOILER CO.

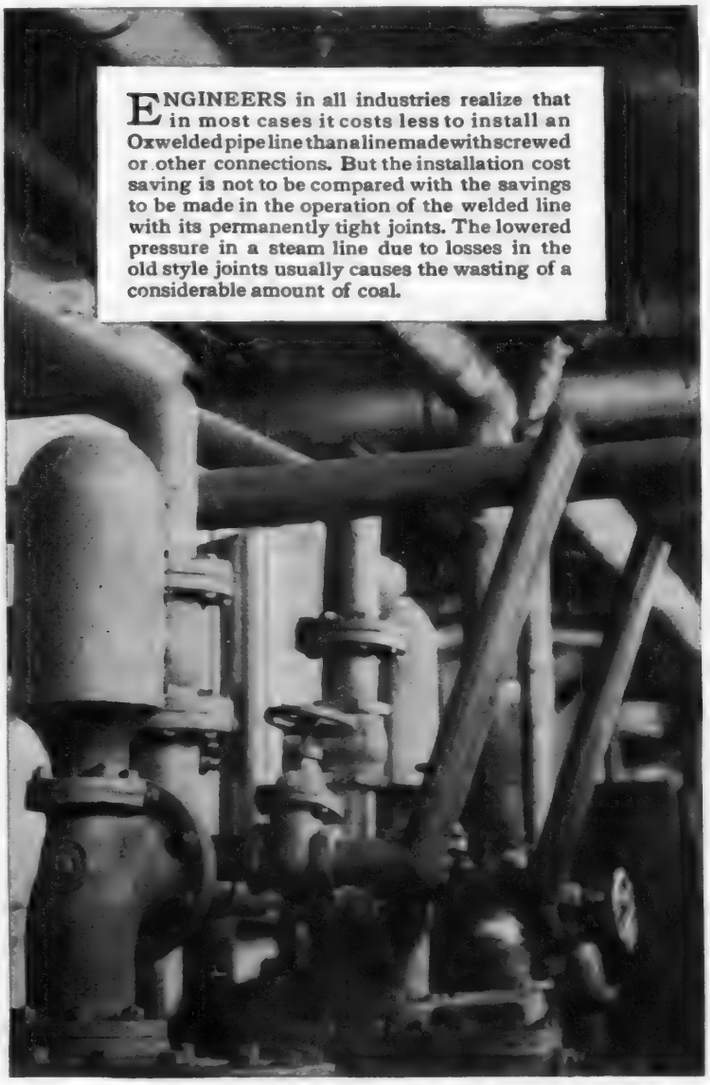
50 West 40th St., New York

Boston — Cleveland
Philadelphia — Meadville
Established 1856 — Incorporated 1877

PAGE BOILERS

"The Distinguished Service Line"

What do you get when you buy Oxweld apparatus?


ENGINEERS in all industries realize that in most cases it costs less to install an Oxwelded pipe line than a line made with screwed or other connections. But the installation cost saving is not to be compared with the savings to be made in the operation of the welded line with its permanently tight joints. The lowered pressure in a steam line due to losses in the old style joints usually causes the wasting of a considerable amount of coal.

1. When you buy Oxweld apparatus you get the apparatus you pay for

All Oxweld apparatus has back of it thoroughly modern factories, an engineering department, and research laboratories. Factories, engineers, and laboratories have but one objective: to design and make the best apparatus possible.

2. When you buy Oxweld apparatus you get profits and economies which you do not pay for

With Oxweld apparatus comes Oxweld service—a service built to make sure that every user understands the operation and care of his apparatus, and in addition that every user saves time or money or improves his product through the use of his Oxweld apparatus.

Oxweld Acetylene Company

LONG ISLAND CITY, N.Y.
Thompson Ave. & Orton St.

CHICAGO
3642 Jasper Place

SAN FRANCISCO
1050 Mission Street

Oxweld

WELDING AND CUTTING APPARATUS

WORLD'S LARGEST MANUFACTURERS OF WELDING AND CUTTING EQUIPMENT

"—it burns $7.00 coal"

A New Molby Boiler is cutting coal bills for Edward T. Child, Larchmont, N. Y. Aymar Embury, II, Architect

The steadily increasing use of the New Molby House-Heating Boiler in all types of buildings conclusively proves that its economy and labor-saving features are all that the maker claims.

The three outstanding features of the New Molby are:—

The Adjustable Side Grate; the Downdraft and Crossdraft which permit complete combustion of No. 1 Buckwheat—the cheap Anthracite—*which costs only about $7.00 a ton.*

And there's the Magazine Feed—which feeds by gravity and requires refilling only every twelve hours.

"Have just placed my order for next season's coal at $6.40 a ton" writes the owner of this store—"I'm well satisfied with the New Molby."

"The Molby far surpasses any heating plant I ever had anything to do with. It requires much less attention and saves me at least 30% in fuel."—Henry Struntz.

Joe Humphrey announces "The boiler is giving excellent satisfaction with little cost of fuel. It scarcely requires any attention. I am very glad to recommend it to anyone."

"The superintendent of the apartment will be glad to add his testimonial to mine. As the boiler is a self-feeder—it saves him hours of labor." William M. Marco, Stephens Fuel Company.

"The boiler saves the fireman labor—as he merely fills it up twice a day" writes the owner of this New York apartment house.

Operates Steam, Vapor or Hot Water System.

Our Service Department is prepared to render you valuable co-operation.

The New **MOLBY**

HOUSE-HEATING BOILER

burns No. 1 Buckwheat

Clubs as well as homes, stores and apartments, find that the New Molby cuts coal bills. Robert Scannel designed the Cloister Inn Club, Princeton, N. J., shown above.

MOLBY BOILER COMPANY

SUBSIDIARY OF IRON PRODUCTS CORPORATION

41 EAST 42d STREET NEW YORK CITY

Send me Molby Buckwheat-Burning Boiler Catalog

*Name*_____

*Firm*_____

*Address*_____

*City*_____ *State*_____

In Omaha

The Pipe Basis for Modern Building

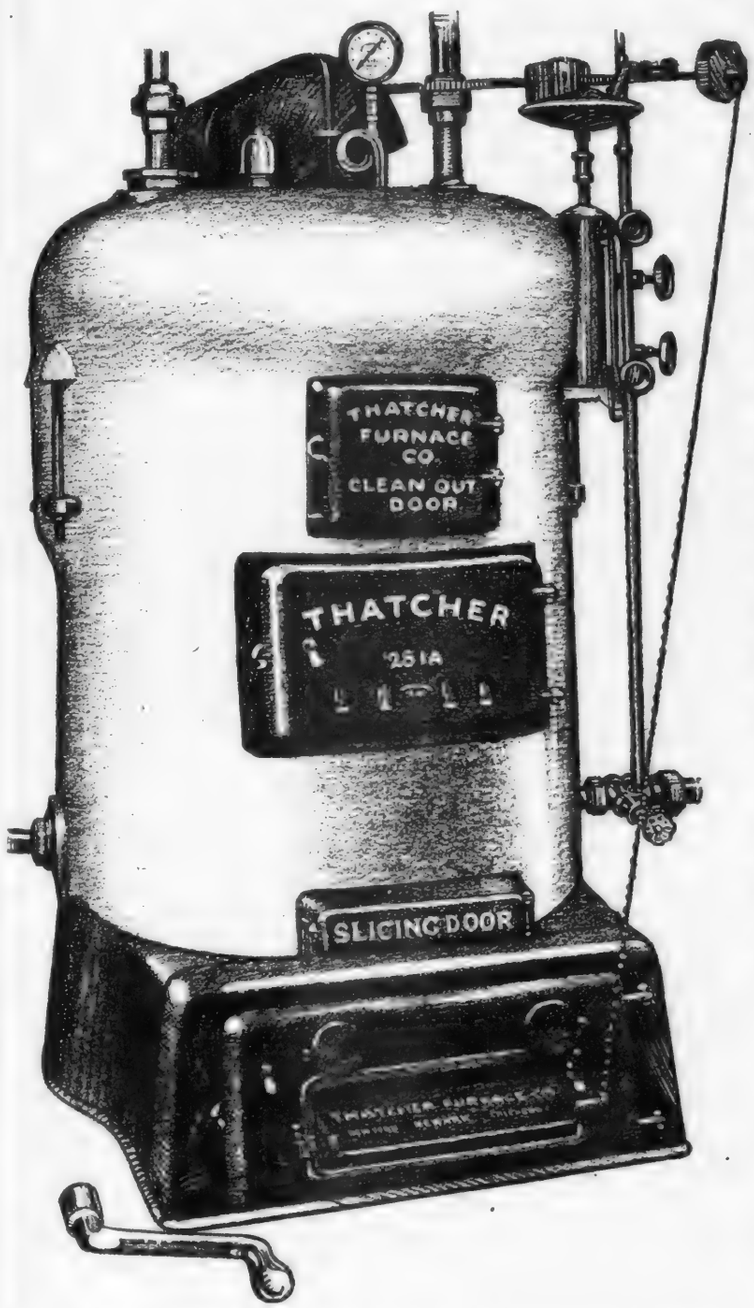
TAKING advantage of situation in the center of the country—Omaha has drawn on the experience of the East, West, North and South in her efforts to raise up from the prairies a city both pleasing to the eye and substantial in character. As a result, her prominent buildings show a combination of good architecture and dependable materials—reflecting credit upon the vision of those who conceived their need and those who helped to put them into form. Incidentally, "NATIONAL" Pipe is used in many of these buildings. The buildings illustrated are taken from Bulletin No. 25—"NATIONAL" Pipe in Large Buildings. This publication contains useful data on pipe for building purposes. A copy will be sent upon request.

NATIONAL TUBE COMPANY, PITTSBURGH, PA.

DISTRICT SALES OFFICES IN THE LARGER CITIES

THATCHER
BOILERS-FURNACES-RANGES

More Heating Surface



More heating surface means more heat, less coal, and a comfortably warm house throughout the cold weather. Thatcher Round Boilers provide this necessary additional direct fire heating surface. Three lobes extend down from the crown sheet and bring the heating surface in the closest possible contact with the hottest part of the fire.

Thatcher Boiler ratings remain *unchanged*, and as always, are most *conservative*. Easy cleaning facilities are provided by the high ash pit. This feature also eliminates the possibility of burned out grates. Troublesome clinkers are crushed and disposed of by the heavy triangular revolving grates which conserve fuel and are simple to operate.

Exact regulation and control of heat is assured by a butterfly door in the ash pit and sensive diaphragm attached to damper in smoke hood.

Thatcher Boilers are not built for ornamental purposes with useless "trimmings." They are built for *service*, reliable service, and will last as long as the house. The coupon below will bring you the Thatcher Boiler Catalog fully illustrated, with complete details.

THE THATCHER COMPANY

Formerly Thatcher Furnace Co.
Since 1850.

133-135 West 35th St. New York City, N. Y.
39-41 St. Francis St. Newark, New Jersey
341 N. Clark St. Chicago, Ill.

Thatcher Round Boilers

The Thatcher Company
39-41 St. Francis St.
Newark, New Jersey

Please send me your illustrated Boiler Catalog.

Name _____

Address _____

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Richards, McCarty & Bulford

HEATING CONTRACTOR
W. H. Conklin Company

Residence in Bexley, Ohio

Gas Heating Gives YOU Greater Satisfaction—and Profit!

YOUR customers are your business. Their satisfaction is your satisfaction—and your best salesman. And Bryant Automatic Gas Heating is a sure, proven source of satisfaction.

Gas, effectively used, is the ideal fuel for winter warmth in homes. It does not require constant attention as other fuels do! Gas is clean—no oily or sooty film to mar interior decorating; no noise or odors; no coal or ashes; no dirty fuel deliveries.

When burned with the 84.5% efficiency of the Bryant Gas Boiler, gas is well within the reach of practically every fine home owner!

Let us tell you the Bryant plan for co-operation with heating contractors. Write today.

THE BRYANT HEATER & MFG. COMPANY
954 East 72nd Street CLEVELAND, OHIO
Branches in Principal Cities

BRYANT HEATING

for Hot Water — AUTOMATIC GAS — Steam *or* Vapor

The LITTLE BUILDING is *Royal* Equipped

Seven years ago, under the direction of Architects Blackall, Clapp & Whittemore and Isaac Coffin Company, Heating Engineers, five S-551 ROYAL Down Draft Smokeless Water Tube Boilers were installed in the Little Building, Boston, Mass.

Inquiry proves that never more than three boilers have been called upon at any one time to serve the 38,000 sq. ft. of direct radiation.

During this period of seven years ROYAL Boilers have enabled the owners to take advantage of the fuel market, and—utilizing oil or coal—the highest degree of efficiency with economy has been obtained.

ROYAL

HART AND CROUSE

UTICA, NEW YORK

BOSTON
CHICAGO
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CLEVELAND
DETROIT
GRAND RAPIDS
MILWAUKEE
NEW YORK
PHILADELPHIA
PITTSBURGH
ST. LOUIS

ROYAL Round, Sectional and Smokeless Boilers

"One guess Betty—What's the nicest thing we have in this house?"
"One guess is all I need, Dick—it's the EverHot Water Heater."

The Joy of EverHot Water

That is the story the picture tells—the pleasure—the comfort—the convenience—of a trouble-free automatic water heater, minus the drawbacks of the old types. No reduction in water pressure—no liming troubles—no condensation—no burner troubles—a heater practically free from the necessity for service—a heater economical in operation and modest in price—that's the heater that builds good good-will for the plumbing and heating contractor who installs it.

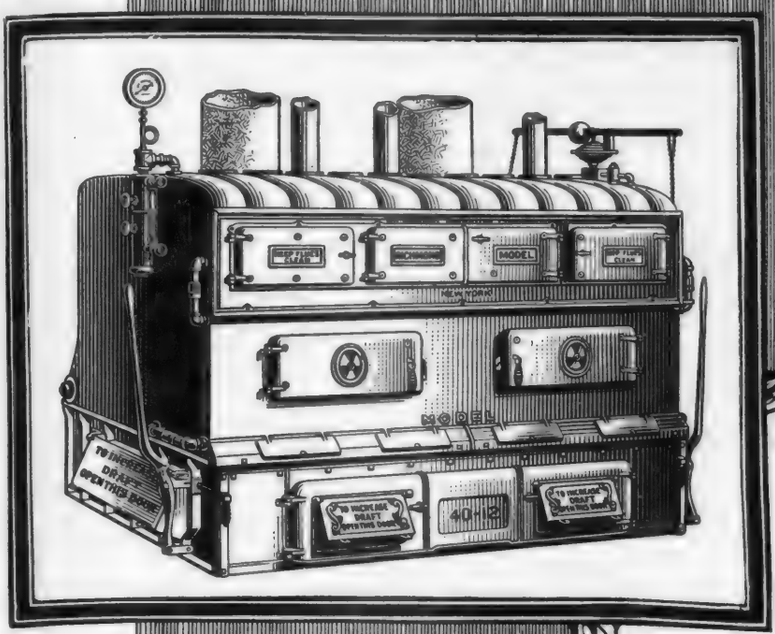
The World Wants EverHot Water

And will have it, too, in time. The country is sold on automatic hot water service. Everyone wants it. Too many, however, think it an expensive luxury. Not everyone knows he can have his home equipped with an EverHot for about the price of a modern gas range.

The old house market for EverHot water heaters is tremendous. Are you getting ready to harvest some of this business? Have you submitted your plan in the contest announced in this paper December 6? Contest closes February 1st. Five minutes' thought may win the prize. Send in your plan now.

EverHot Heater Company

5215 Wesson Avenue :: :: Detroit, Michigan



"RICHMOND"

The Model Boiler is the embodiment of efficient heating surface, circulation, compactness, ease of cleaning, accessibility, simplicity, and economy in consumption of fuel.

The Model Boiler is essentially a water tube boiler, which means that in circulation the water is given preference over the gases from the fire. Engineers recognize the tremendous energy which is wasted when impeding the circulation of water, no matter whether in pipes or in boiler sections. In the Model Boiler there is no impediment whatsoever. The water has a free and unobstructed flow from the bottom to the top. Friction is reduced to a minimum.

Model Boilers are made in four lengths of firebox —18, 22, 30 and 40 inches.

Because greatest length of grate is only 40 inches it is possible to keep uniform fire over entire grate —no "dead" fire or ashes in rear of firebox as is true of boilers having firebox of 6 or 7 feet in length. Each added section means the addition of grate and heating surface and flue area of proper proportion.

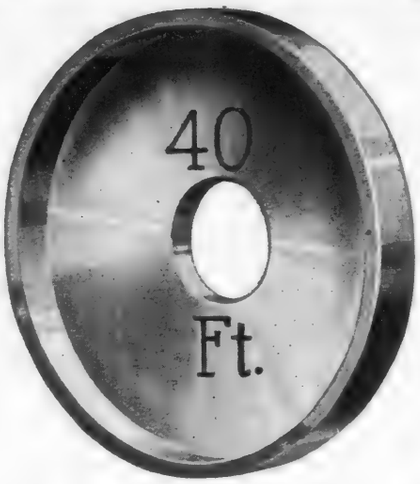
Model Boilers are Code Boilers—they are rated according to formula of American Society of Heating and Ventilating Engineers.

RICHMOND RADIATOR COMPANY

MAIN OFFICE:
1480 Broadway, NEW YORK, N. Y.

Branch Offices:
2241 North American Street, PHILADELPHIA, PA.
217 East Illinois Street, CHICAGO, ILL.
460 Park Square Building, BOSTON, MASS.
900 Keith Building, CLEVELAND, OHIO
316 Fulton Building, PITTSBURGH, PA.

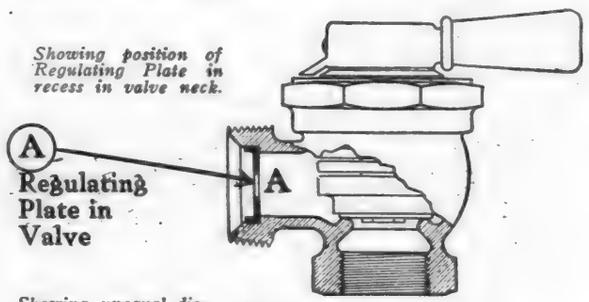
The orifice in each regulating plate is proportional to the size of the radiator on which the plate is used.



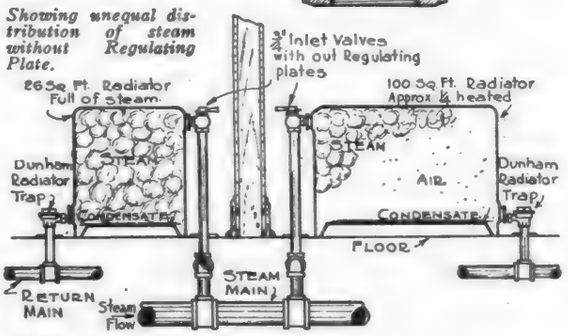
It will be noted by the illustration that the plate is plainly marked with the sq. ft. surface of the radiator for which it is designed.

An important DUNHAM development

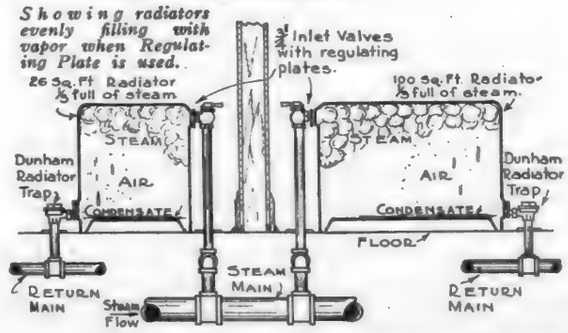
Showing position of Regulating Plate in recess in valve neck.



Showing unequal distribution of steam without Regulating Plate.



Showing radiators evenly filling with vapor when Regulating Plate is used.



THE Dunham Regulating Plate marks an important step in the development of the ideal home heating system.

By means of this plate the correct proportion of vapor necessary to properly heat each radiator is exactly provided. As will be noted by the illustrations, the Dunham Regulating Plate is inserted in a recess in the neck of the valve, the orifice in the plate being calibrated to the number of feet of radiation in each radiator.

The use of the Dunham Regulating Plate simplifies many things which have been serious barriers to progress in the art of heating, *for without this plate*

—The resistance which steam vapor encounters in flowing from the boiler to the radiator cannot be the same for each radiator.

—The resistance opposing the flow of condensate and air from the radiator to the boiler is not uniform for each radiator.

—The size of the opening through which the steam vapor flows to each radiator is not closely proportioned to the supply required by the radiator.

—The steam is not always maintained at the pressure for which the piping is designed.

The Dunham Regulating Plate overcomes these difficulties and thus Dunham again leads in further progress toward the irreproachable vapor system.

For futher information regarding the Dunham Regulating Plate and its application address

C. A. DUNHAM CO.

230 East Ohio St. Chicago

Over sixty branch and local sales offices in the United States and Canada bring Dunham Heating Service as close to your office as your telephone. Consult your telephone directory for the address of our office in your city.

The DUNHAM
REG. TRADE MARK
HEATING SERVICE

Continental

BOILERS & RADIATORS

How Continental Low Water Line Boiler Economies are *Engineered In*

PICK apart the design of the Continental Low Water Line Boiler and you will see how its installation, operating and fuel economies have been *Engineered In.*

Low Water Lines — 43" and 47"
eliminate costly and refuse-gathering pits. Provide ample distance between water line and low point of main.

Balanced Circulation and Ample Water Capacity
prevents priming, assures quick steaming with maximum heat absorption and maintains a steady water line.

Water Tubes in Direct Contact With Flames
Intense heat of fire rises to crown sheet, then travels thru flue-ways surrounded by coldest water for greatest heat absorption before reaching chimney.

Side Feed — Easy to Fire
Coal is thrown short way of the grate. Grate bars shake in series of two or three, giving perfect fire control. Burns any kind of fuel including oil.

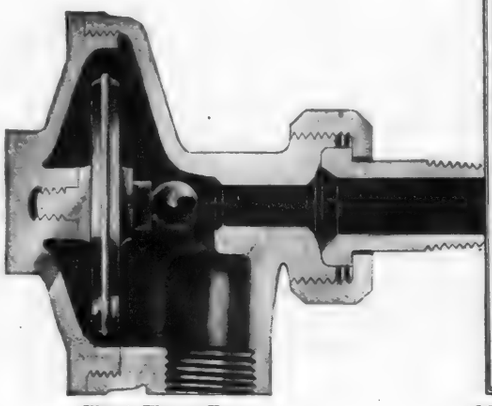
Grate Bars Easily Accessible
Can be removed and replaced without crawling into fire box or ash pit. With slicer door at end of grates, the bars can be turned at an angle and clinkers easily removed.

Balanced Draft Doors
Easily operated by the most sensitive damper regulator for accurate temperature control.

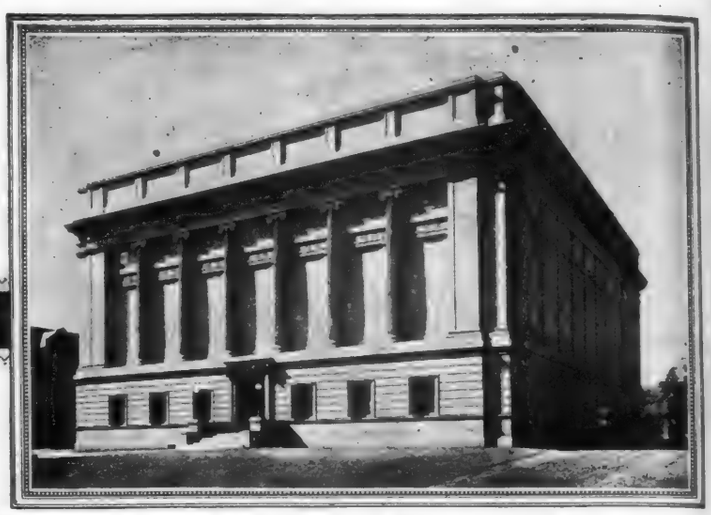
The Continental Low Water Line Boiler is designed to meet actual installation requirements rather than ideal laboratory conditions. It has an international reputation for high boiler efficiency under actual working conditions. Send for the Continental Book, it gives the whole story of Continental Boilers and Radiators.

Continental Heater Corporation
Home Office and Factory
Dunkirk, N. Y. U.S.A.

BUILT FOR BETTER HEATING



Illinois Thermo Trap



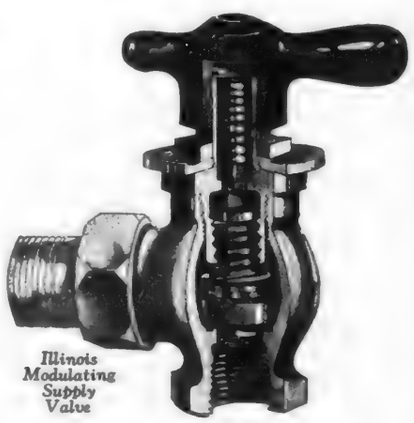
Masonic Temple, Paterson, N.J. F.W. Wentworth, Architect. G.S. O'Neil, Heating Contractor

Nearly a Quarter-century of Technical Leadership Has Demonstrated the Value of Illinois Heating Systems in Control and Economy of Operation

This long record of satisfactory service, these years of successful operation, eliminate all elements of chance in the use of *Illinois Heating Specialties.*

Specify and use these Specialties with every assurance of satisfaction to your client.

Illinois Products are distinguished by long life, ease of control and economy of operation. They are guaranteed to give satisfactory service.



Illinois Modulating Supply Valve

ILLINOIS
HEATING SYSTEMS

Our Engineering Department cooperates efficiently with engineers and architects in developing details of design, installation and efficiency. *Write for Bulletin No. 25.*

ILLINOIS ENGINEERING COMPANY

INCORPORATED 1900

ROBERT L. GIFFORD, *President*

General Offices and Factory: CHICAGO, ILLINOIS

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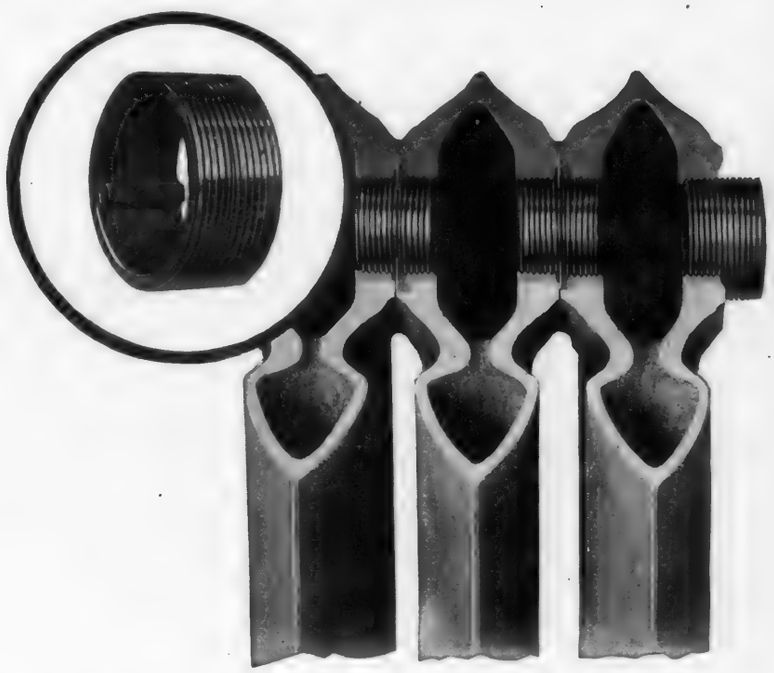
Consult Local Telephone Directory

Screw Nipple Radiator Joints



cost more to make

BETWEEN the loops of every American Radiator is a Screw Nipple—made of *malleable* iron.

The equipment to make these screw nipples cost us several million dollars. The cost of manufacturing them is more than twice as great as the cost of making old-fashioned slip nipples that are forced into place by pressure and have to be held in place by tie-rods. But—

Your clients pay no more for these advantages:

1—Makes a joint that lasts forever.

2—Makes a joint that cannot rust out.

3—Makes a joint that does not leak.

4—Makes a joint that maintains perfect alignment.

5—Withstands the stress and strain of rough handling in shipping.

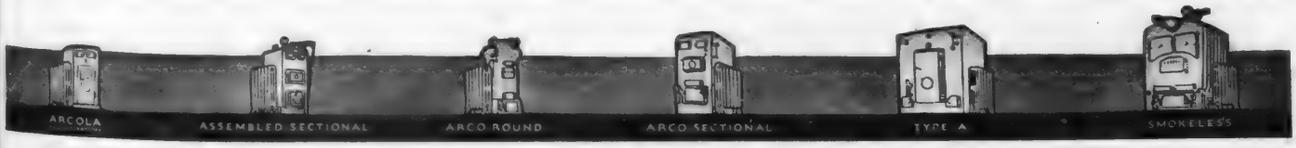
6—Eliminates unsightly tie-rods and bolts which collect dust and dirt.

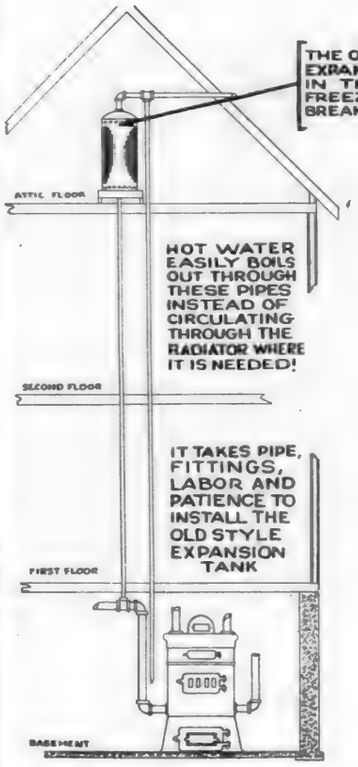
When you choose the American *Screw Nipple* Radiator for your client, you are insuring him all these advantages, and without additional cost.

AMERICAN RADIATOR COMPANY

Dept. T-40, 1807 Elmwood Avenue, Buffalo, N.Y. *Sales Offices in all principal cities*

IDEAL BOILERS AND AMERICAN RADIATORS FOR EVERY HEATING NEED




THE OLD STYLE EXPANSION TANK IN THE ATTIC FREEZES AND BREAKS BOILERS
ATTIC FLOOR
HOT WATER EASILY BOILS OUT THROUGH THESE PIPES INSTEAD OF CIRCULATING THROUGH THE RADIATOR WHERE IT IS NEEDED!
SECOND FLOOR
IT TAKES PIPE, FITTINGS, LABOR AND PATIENCE TO INSTALL THE OLD STYLE EXPANSION TANK
FIRST FLOOR
BASEMENT

Ordinary Hot Water Heating Plant — UNREGULATED — UNCONTROLLED

Thrush HOT-WATER HEATING *SYSTEM is better!*

Modern heating engineers recommend and endorse the closed or controlled and automatically regulated system of hot water heating. Thrush System provides perfect control. It prevents easy boiling, speeds up circulation and makes hotter radiators. It can be installed on old plants as well as new with very little expense and labor. It provides uniform heating, prevents waste of coal, and lessens the attention required.

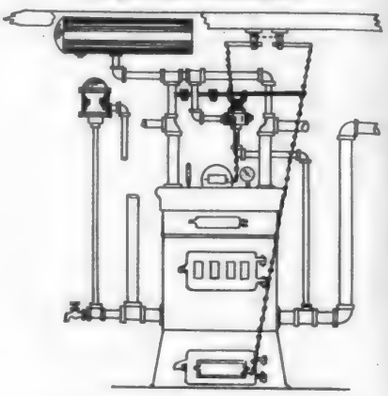
COMPARE!

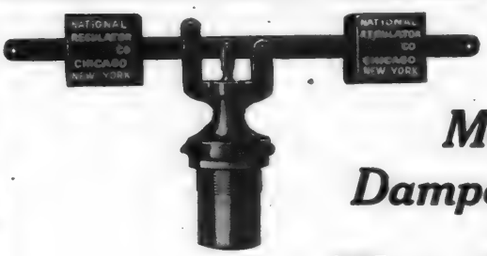
The illustration at the left shows the ordinary installation, uncontrolled and unregulated. At the right we show Thrush System which is automatically regulated and controlled. Notice how compact and simple the installation is. Figures prove it is no more costly to install a Thrush Controlled System than it is to install the ordinary gravity type.

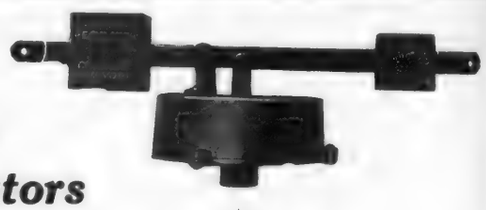
Write for Catalog

H. A. THRUSH & CO.
PERU, IND.

THRUSH* HOT-WATER HEATING SYSTEM. *Regulated-Controlled
All in the Basement

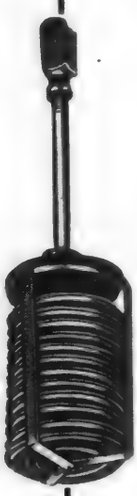






Metaphram Damper Regulators

The Complete Line



The most important development in years in hot water regulator construction, combined with simplicity, is the new Nationml Type F-2" "Cage Assembly."

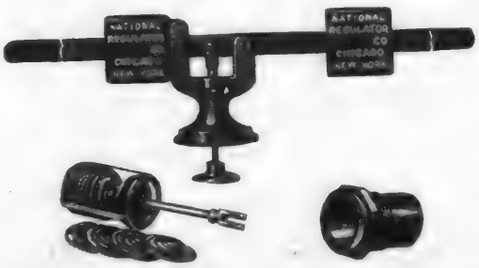
The Metaphram unit is contained in a light brass cage and may be lifted from the well instantly should replacement become necessary. The unit consists of new separable Metaphram discs instead of a built-up unit.

Extremely sensitive and with Metaphram acting directly upon the damper lever it is the simplest regulator of its type on the market. All parts are perfectly interchangeable. As well as a hot water boiler regulator, it is used in connection with tanks on domestic heaters.

Our type F-2" has always led the field; and with our added new feature—the "Cage Construction"—we have made the best still better.

Metaphram Steam Damper Regulators are made in all sizes and for all conditions under which low pressure Boiler Regulators are operated. They are made in five sizes, viz. Type A-Jr., Type A, Type B, Type C and Type D.

They are universally used by the best Manufacturers of boilers. There is a size for every boiler size and style. Send us your requirements in order that we may quote you quantity prices on various sizes.



NATIONAL REGULATOR CO.

FACTORY AND GENERAL OFFICES
2301 Knox Avenue
CHICAGO

European Office: A. J. Aubeton, 18 St. Thomas St., London, S. E. 1, England

Side by Side

Two IDEAL Boilers warm this fine New England home—a 3-G-40 Gas Boiler and an ARCO Round coal-fired boiler. They are operated either separately or together—a most convenient and flexible arrangement.

Heating Contractor: O. F Bennett, Haverhill, Mass.

Let your Gas Company help you sell *two* IDEAL Boilers instead of only one

THERE ARE surprisingly many boiler prospects who would willingly pay the cost of having *two* boilers in the basement, once the efficiency and convenience of a small gas-fired boiler are demonstrated to them.

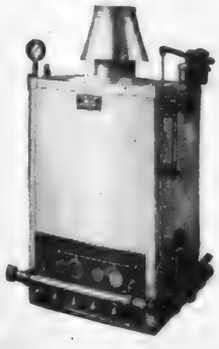
You know how many days there are when the big boiler must be run at a mere fraction of capacity. You know even better than your customer how wasteful this is.

But do *both* you and your customer know that IDEAL Gas Boilers operate at full rating and efficiency from the very minute the temperature regulator snaps on the gas, and is entirely inoperative when it snaps the gas off?

There is no waiting for heat, no low efficiency point. In only 1/6 second of flue travel the staggered-pin surface absorbs 1700° F of the total 2000° F of heat.

So, in moderate winter weather, the compact little IDEAL Gas Boiler will do all the work, self-regulating and without attendance. In severe weather, it boosts temperature with just an occasional "kick" and thus avoids over-driving the coal-fired boiler, or running the big boiler in "little boiler weather."

Product of
AMERICAN RADIATOR COMPANY



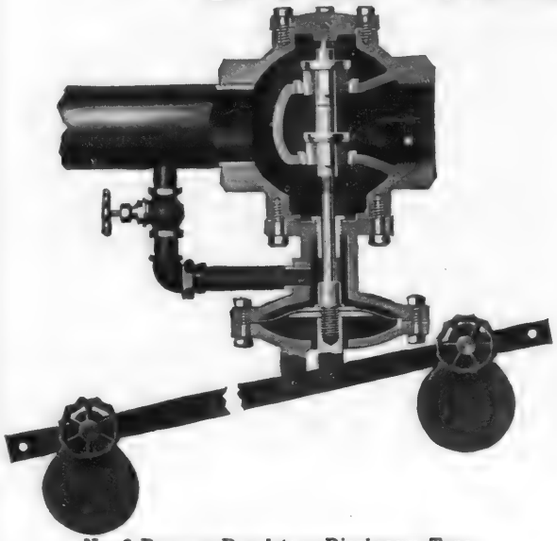
Your Gas Company is your jobber on IDEAL Gas Boilers, and will not only extend you helpful selling co-operation, but will handle servicing and back-calls. What other non-coal-burning installation offers such advantages? Think it over—then write us or see your gas company. They speak the "B.T.U." language also and will work loyally with you. They're good people to know.

THE A. H. WOLFF GAS RADIATOR CO.

376 Lafayette Street *Distributors* New York City

KLIPFEL PRESSURE REGULATING VALVES

SIMPLE — RUGGED — DIRECT ACTING



No. 3 Pressure Regulator—Diaphragm Type
Made in sizes ⅜ to 14 in. inclusive—Std. and Ex. Hvy.
Sizes 1¼ in. and under made with bronze bodies—screwed ends only.
Sizes 2 to 6 in. inclusive made with iron bodies—screwed or flanged ends.
Sizes 7 in. and above made with iron bodies—flanged ends only.
Also made with expanded outlets.

No. 3 Pressure Regulators (Diaphragm Type) are intended for use in connection with vacuum, atmospheric, or low pressure heating systems. They can also be used for the control of air, water or gas.

Operation is very sensitive and is governed entirely by the pressure existing in the low pressure main. Functions automatically and will maintain reduced pressure constantly regardless of fluctuations in the boiler pressure.

No troublesome springs, toggles, stuffing boxes or pilot valves. Valve stem is placed entirely within the valve body and neck, so that a bronze guide bushing with an easy sliding fit can be used in preference to a stuffing box.

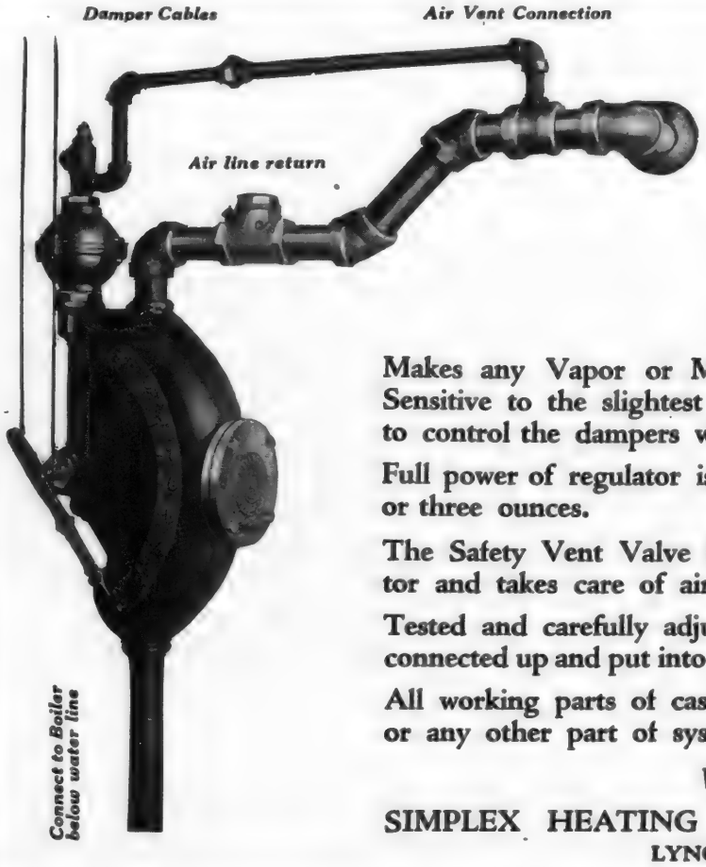
Simple, rugged, direct acting and visible in action. Position of inner valve may be easily judged by looking at the lever, which may be used to open, close or test by hand. Lever can be placed either in line with or at right angles to the pipe line.

Inner valves and seats are bronze bevel seated. Working parts can be removed without disturbing valve body. Condensation on top of diaphragm effectively prevents vulcanizing. Because of the frictionless valve stem and the exceptionally large diaphragm, close regulation is assured at all times.

KLIPFEL MANUFACTURING CO.

2641–59 W. HARRISON ST. CHICAGO, ILLINOIS

Manufacturers of a Complete Line of Steam Specialties:—Piston Type Regulators—Float Valves—Pump Governors—Back Pressure Valves—Relief Valves—Grease Traps—Steam Traps and many other Specialties
Sold by Leading Jobbers Everywhere—Write for Catalog No. 20.



Wiley

Safety-Vent Vapor Regulator

POWER IS ITS MIDDLE NAME

Makes any Vapor or Modulating System safe and satisfactory. Sensitive to the slightest change in pressure. Has ample power to control the dampers with a good working margin.

Full power of regulator is exerted within a pressure range of two or three ounces.

The Safety Vent Valve is a distinguishing feature of this regulator and takes care of air from entire heating system.

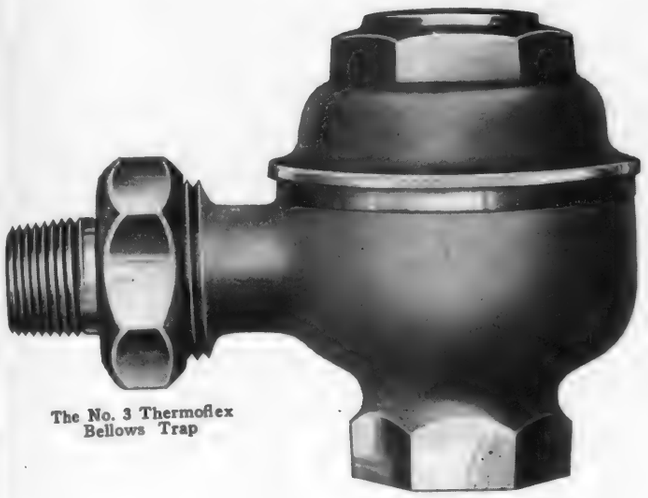
Tested and carefully adjusted before leaving factory, ready to be connected up and put into service, with the least trouble and expense.

All working parts of cast bronze. Will last as long as the boiler, or any other part of system.

Write for details

SIMPLEX HEATING SPECIALTY COMPANY, Inc.
LYNCHBURG, VA.

STOP and READ



The No. 3 Thermoflex Bellows Trap

THE W.D. CASHIN CO. THERMOFLEX HEATING

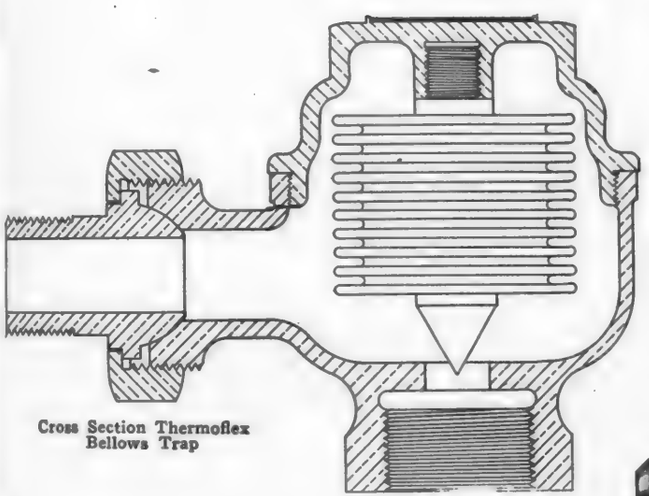
specialties are going strong; the line is complete from start to finish and quality predominates.

Twenty-seven years successful experience assures you satisfaction and we guarantee it.

We show a few of them below.

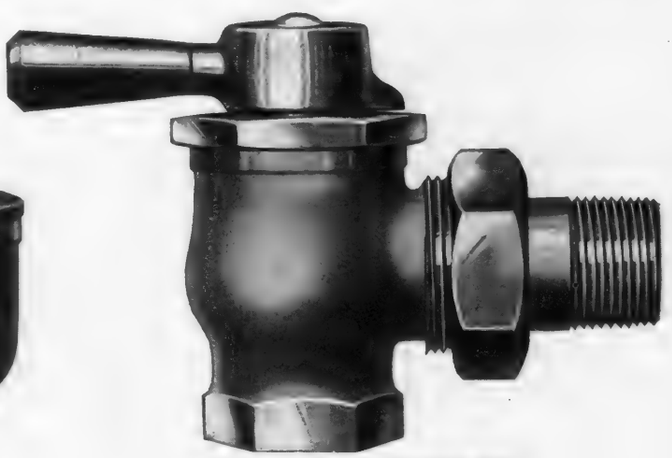
Our complete bulletin catalog shows them all.

It will be a pleasure to mail you one if you wish.



Cross Section Thermoflex Bellows Trap

SPECIFY W.D. CASHIN CO. THERMOFLEX



The Packless Graduated Inlet Valve

The No. 1 and No. 2 Trap

W. D. CASHIN COMPANY

35 HARTFORD STREET :: :: BOSTON, MASS.

Russell "Watch" Valve

DIFFERENT FROM ALL OTHER AIR VALVES

Russell Perfect Thermo–Metal Non-adjustable Automatic Air Valve

The best valve that over thirty years of experience can produce

These valves are also made for vacuum

Consult your Jobber

Russell No. 7
List Price $2.50 each

No. 11–¼" Outlet
For Coils and Mains
List Price $3.50 each

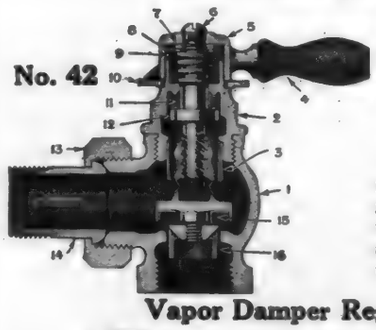
W. A. RUSSELL & COMPANY

Grand Central Terminal Building — *Founded 1890* — NEW YORK CITY

—BRANCHES—

The Straus Bldg. CHICAGO, ILL.
Chemical Bldg. ST. LOUIS, MO.
46 Cornhill BOSTON, MASS.

McALEAR SPECIALTIES FOR VAPOR HEATING SYSTEM



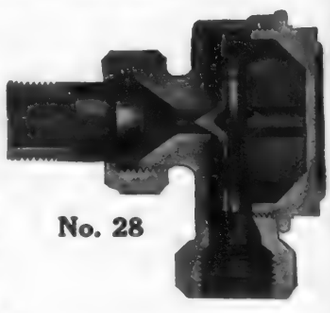
No. 42

Packless Radiator Valves

Quick-opening, nickel-plated brass body. Fig. 38, angle pattern, wood wheel handle; Fig. 42, angle pattern, graduating type, lever handle.

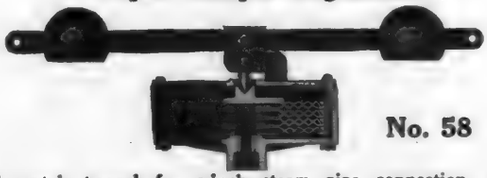
Radiator Traps

Discharge air and water in large quantities. Close tight against steam. Noiseless in operation. Nos. 28 and 28-A of steam metal, furnished N. P. unless otherwise specified. Nos. 28-A and 29-A have right and left-hand discharge openings. Nos. 29, 29-A, 33, 34 and 36 have iron bodies and brass caps, furnished plain unless otherwise specified.



No. 28

Vapor Damper Regulators



No. 58

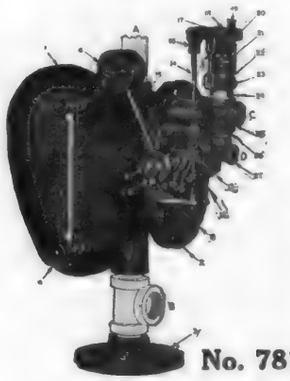
All metal, tapped for 1-inch steam pipe connection. Shipped complete with lever and two weights, S hooks, 2 ceiling pulleys and 12 feet of No. 10 plumbers' chain.

No. 56 for 0 to 3 pounds pressure, constructed with bellows of 10-inch flexible walls. No. 58 for 1 to 15 pounds pressure, constructed with bellows of 6-inch flexible walls.

Combination Float and Thermostatic Ball Check Valves

For venting supply and return mains of heating systems. These air valves close tight against water and steam, and by use of the check prevent the atmospheric pressure from entering the discharge opening.

No. 15



No. 781

Air Eliminator and Return Traps

For automatically returning the water of condensation direct to boiler and discharging air. Minimum distance between water line of boiler and bottom of trap should be 18 inches. "A"—inlet to trap; "B"—discharge to boiler; "C"—steam connection to boiler; "D"—air vent.

THE McALEAR MFG. CO.

1901-7 S. Western Ave.
CHICAGO, ILL.

New Bedford, Mass. Women's Club. F. E. Earle Co., Heating Contractors. Hammond & Sons, Architects. Adsco Heating, Individual Boiler Supply.

Three Residences in Portland, Me. All enjoy Adsco Heating, Individual Boiler Supply.

Kansas City Title & Trust Co. 550,000 cu. ft. of space kept comfortable by 9,669 sq. ft of radiation. Adsco Heating, Steam from Underground Distribution Mains of Kansas City Power & Light Co.

Occupants of these buildings Have No Heating Problem

At each radiator is an Adsco Valve that controls heat as a faucet controls water. There's no need for overheating rooms; thus heat is saved, and greater comfort secured.

In the basement is a regulator that maintains constant pressure throughout the system.

Adsco Heating saves money for the owners because less fuel is needed. Savings of 15% to 25% are common.

It is inexpensive to install, as no air valves are required.

Adsco Heating operates with economy and satisfaction in every type of building. It can be used in big installations with traps if desired.

If you plan to build or remodel, write for our Folder No. A-53-H (Hot water systems can be changed to Adsco Heating.)

The Adsco Graduated Packless Radiator Valve Controls steam as a faucet controls water.

AMERICAN DISTRICT STEAM COMPANY

GENERAL OFFICES AND WORKS

NORTH TONAWANDA, N.Y.

OFFICES:

New York Chicago Seattle

If interested in heating a group of buildings from a central steam generating station, ask for booklet No. 20-H

ADSCO HEATING

OVER 1,000
GORTON
Quarter Turn
PACKING LOCK
VALVES
used on the Hot Water Heating System under pressure (forced circulation)
Of the 14 Buildings, eight are six stories high
Hudson View Gardens
182nd to 190th Streets, Pinehurst and Northern Avenues New York
New Tenant Owned Apartments
PATERNO CONSTRUCTION COMPANY, Builder
GEORGE FRED PELHAM, Inc., Architect
GEORGE F. MUSSELMAN, Consulting Engineer
WOOD, DOLSON COMPANY, INC., Agents
J. L. MURPHY Inc., Heating Contractor
GORTON & LIDGERWOOD COMPANY
96 Liberty Street, New York

How do CLARAGE HVs perform on average jobs?

(problem is solved on next page)

Less Power . . .

Smaller Motor . . Lower Speed

THE EXPERT will ***not*** overlook the Clarage NEW Type HV Fan—77% efficient. Indeed, this fan's ability to effect economies on all types of heating and ventilating jobs is so startling as to merit ***closest*** investigation. ***No other*** multiblade fan approaches the NEW HV for efficiency and silence of operation. ***No other*** multiblade makes possible such substantial savings in first cost and operating expenses.

The following comparison of fan performance is ***typical.***

Solving the Problem

Assume necessity to select fan (slow speed multiblade type) for heating and ventilating to deliver 42,000 C. F. M. at 1¼ inches Static Pressure.

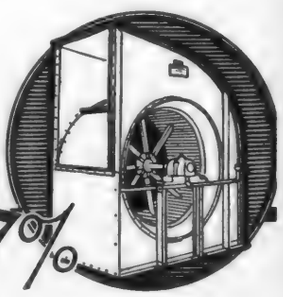
Average Multiblade Performance - - -	42,000 C. F. M.
(Average in this case means our older Type M Fan equally as efficient as any other multiblade—*except NEW Clarage HV.*)	1¼" S. P.
	190 R. P. M.
Requires 20 H. P. Motor to Drive →	**15.8 H. P.**
NEW HV Fan Performance - - - -	42,000 C. F. M.
	1¼" S. P.
11% Lower Speed (more silent) →	**169 R. P. M.**
Use 15 H. P. Motor: 21% Power Saving →	**12.5 H. P.**

Write for More Facts!

We have further convincing proof of the superiority of the NEW HV Fan. You, an expert ***should have*** this complete information. A Clarage engineer will gladly place all of the facts before you -- and without obligation. Write us today.

CLARAGE FAN COMPANY, Kalamazoo, Mich.

SALES ENGINEERING OFFICES IN 18 PRINCIPAL CITIES



CLARAGE MULTIBLADES

New Type HV *maximum efficiency* 77%

Quality materials and workmanship—proven efficiency of operation—special Dole thermostatic principles—these are the factors that make the Dole Syphon Air Valve in great demand all over the United States.

The efficient construction of the venting seat—the improved Dole syphon—the special syphon lock collar and the float rest are a few of the special features with which every up-to-date steamfitter should be familiar.

If you want a better air valve at a lower price, send for our diagram blue print showing detailed specifications

THE DOLE VALVE COMPANY, 1923-33 Carroll Ave., Chicago, Ill.

The Best HEATING EQUIPMENT is none too good

At the Largest Statistical

Hotel at Babson Park (at right)

Research Libr Babson Par (below)

Aim of ROGER BABSON

THE chief aim of Mr. Babson, in the creation of Babson Park, is to give economic perspective and comprehensive appreciation of business to young men who are to occupy positions of authority, responsibility and trust, by providing a short course of intensive training in the fundamentals of business.

The value of Babson Institute to business men is indicated by the admission requirements and the fact that the Institute must limit the number of students. Exclusive of all expenditures for board, lodging or of a personal nature, the regular first year tuition charges alone are $2,000.

At Babson Park is to be found also a statistical organization which is made up of the recognized leading economic authorities of the country. This organization is called upon to serve manufacturers, bankers and other business leaders and is recognized justly as the largest organization of business advisors in the world. It maintains a large staff and has branch offices in all large cities in this country and in Canada.

The leading business minds of the country make a pilgrimage to Babson Park each Summer for the Annual Babson Conference, held for the purpose of informal discussion of the most important current business problems.

In planning buildings to house his many departments Mr. Babson specified only the best. All the buildings at Babson Park are equipped with *Barnes & Jones* Heating System.

Barnes

VAPOR and VACUUM

If Best for the Bigges

B&J

5 MELROSE STREE

BARNES & JONES

for Roger Babson

Community in America

Trades Association Building Babson Park (below)

Administration Bldg. Babson Institute (at left)

& Jones

IEATING APPARATUS

's the Best for You!

OSTON, MASS., U. S. A.

B&J

Aim of BARNES & JONES

THE chief aim of *Barnes & Jones* in the manufacture of their Vapor and Vacuum Heating Apparatus is to give the maximum in heating efficiency for every type of building.

Roger Babson is not alone in his selection of *Barnes & Jones* nor is *Barnes & Jones* System specified only for buildings of the types found at Babson Park.

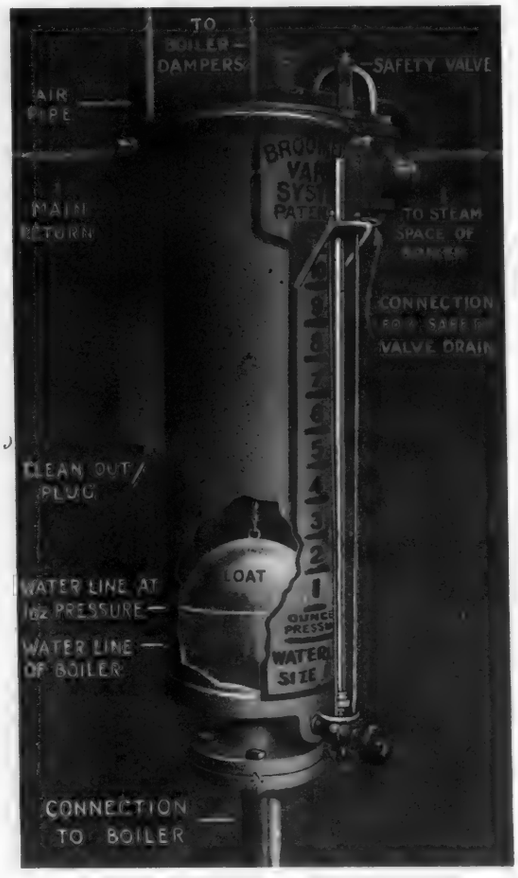
There is a *Barnes & Jones* System for the largest office building possible to build. The Park Square Building in Boston, the sixth largest office building in the world, and the First National Bank Building, the most expensive office building in New England, together with many others of the same high standard of excellence, are equipped with *Barnes & Jones* Heating System.

There is a *Barnes & Jones* System for the finest university and public school building, of which the University of Pennsylvania and the Morgan Gardner Bulkley Memorial High School, Hartford, are illustrations. They are *Barnes & Jones* equipped.

For the modest home or the palatial residence there is also a *Barnes & Jones* System. The magnificent home of Vincent Astor, where His Royal Highness, the Prince of Wales, was entertained recently, is one of the dwellings heated by *Barnes & Jones.*

Bloomingdale Hospital, New York; the Dutch Reformed Church, Poughkeepsie and the Riverside & Dan River Cotton Mills, Virginia, are examples of other types of buildings which are *Barnes & Jones* equipped.

Barnes & Jones products are quality products. The appliances embody so far as possible all the advantages of engineering efficiency that twenty-five years of experience has shown they should possess.



Broomell System

This Combined Automatic BROOMELL SYSTEM Receiver, Damper Regulator, and Pressure Gauge, together with the boiler forms the heart of the Broomell Vapor System.

The water of condensation is discharged into the Receiver, and by it returned to the boiler.

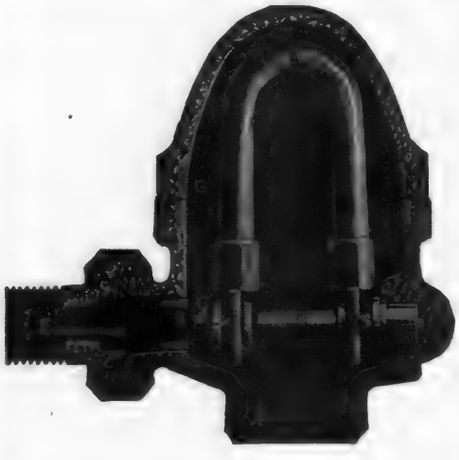
The air from the radiators is removed (via return piping) through this Receiver, being carried off from the top of the Receiver by air line and discharged into the flue.

It likewise automatically controls the draft of any type of boiler, and may be adjusted to insure perfect heating service through any extremes of outside temperature, closing the draft at any desired point, from zero to 8 ounces, in very cold weather. In moderate weather, it is usually set to close the draft at 1 or 2 ounces.

VAPOR HEATING COMPANY

YORK, PA.

New York Philadelphia Boston Washington



The Perfect Automatic Valve for Vacuum or Vapor Heating

The "Vento" Automatic Valve represents a steady improvement in the Haines line of steam traps and offers the highest degree of steam trap efficiency.

There has been no change in the old reliable principle that has placed Haines Automatic Valve in a class by itself. The operating power is identical—the only difference being in the general construction.

Special features are: Horizontal mounting of valve mechanism—long range of movement—positive action—quick opening and closing.

"VENTO" Advantages

System starts with valve wide open, assuring circulation almost the instant steam is turned on.

Control of valve opening from two to eight times larger than other makes of valves.

Size of valve opening reduces danger of fouling with scale or other foreign matter.

Closes absolutely tight against steam. No necessity for use of spray water at pump.

Cannot stick or gum from foreign matter, and operation is absolutely noiseless.

Send for booklet

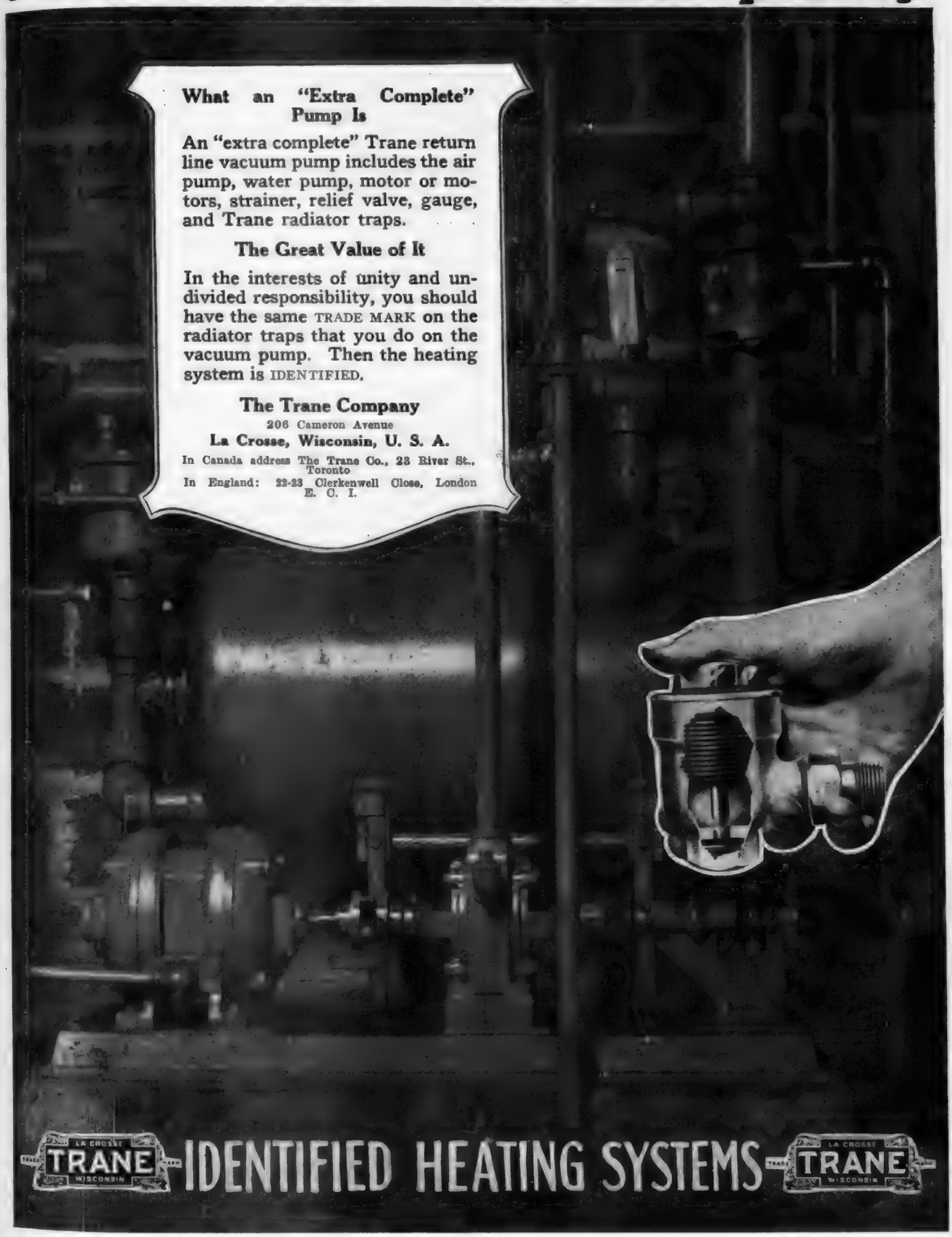
WILLIAM S. HAINES & CO.

12th & Buttonwood Streets

PHILADELPHIA, - - PA.

VENTO

Another Trane "extra complete" return line vacuum pump


What an "Extra Complete" Pump Is
An "extra complete" Trane return line vacuum pump includes the air pump, water pump, motor or motors, strainer, relief valve, gauge, and Trane radiator traps.
The Great Value of It
In the interests of unity and undivided responsibility, you should have the same TRADE MARK on the radiator traps that you do on the vacuum pump. Then the heating system is IDENTIFIED.
The Trane Company
206 Cameron Avenue
La Crosse, Wisconsin, U. S. A.
In Canada address The Trane Co., 23 River St., Toronto
In England: 22-23 Clerkenwell Close, London E. C. I.
LA CROSSE TRANE WISCONSIN
IDENTIFIED HEATING SYSTEMS
LA CROSSE TRANE WISCONSIN

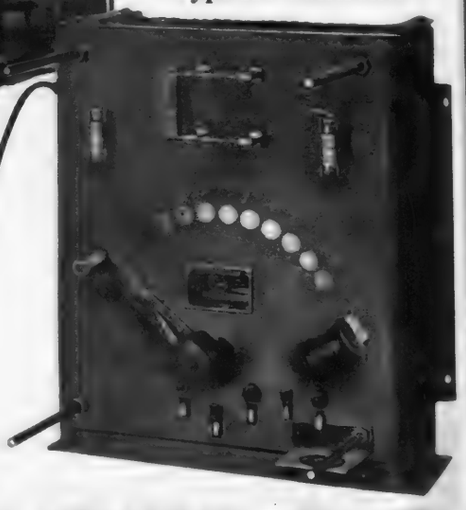
Top

The new addition to Macy's store
Architect: Robert D. Kohn
General Contractor: Marc Eidletz & Sons
Heating and Ventilating Contractor: Gillis & Geoghegan

Bottom

Saks & Company's new store
Architects: Starrett and Van Vleck
General Contractors: Cauldwell and Wingate
Heating and Ventilating Contractor: Gillis & Geoghegan

Type HS Controller



Westinghouse

X78415

In the Newest Stores

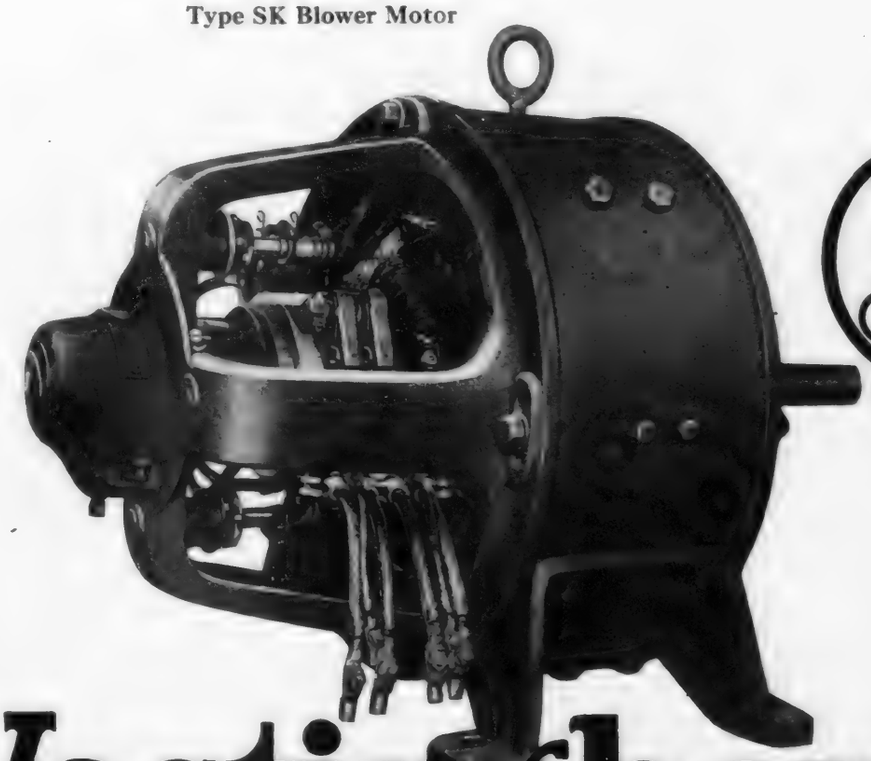
The R. H. Macy & Company, for the recent addition to their store, and Saks & Company, for their new building, have both selected Westinghouse motors and control for use with their heating and ventilating systems.

To store owners, Westinghouse motors bring the constant satisfaction of silent operation and economical performance. To architects and consulting engineers, their unfailing service is a confirmation of sound judgment and a basis for engineering reputation.

Consult with Westinghouse engineers for the selection of motors and control for heating and ventilating systems.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pennsylvania
Sales Offices in All Principal Cities of the United States and Foreign Countries

Type SK Blower Motor



W
WESTINGHOUSE ELECTRIC

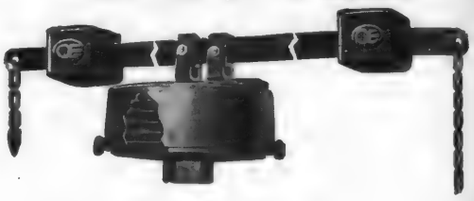
Westinghouse

X78416

THE O-E 3 IN 1 HEATING SPECIALTIES

TRADE O-E MARK

No. 2 "O-E" (3 IN 1) Regulator



Three Systems in One

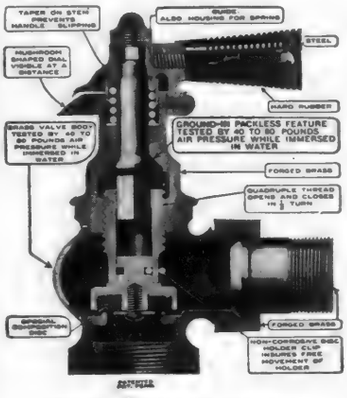
Vapor, part of the time.
Vacuum, most of the time.
Pressure, when wanted.

Insure Efficiency Heating

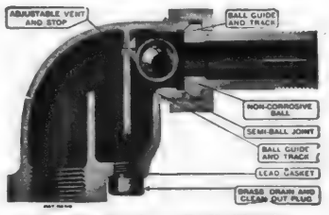
The O-E System of Heating is based on a thorough knowledge of heating requirements. Every part represents high grade manufacture and workmanship, and simplicity eliminates the possibility of trouble. Costs less to operate and gives more heat.

Our claim for high efficiency is not based entirely upon our own opinion of O-E performance. Severe tests by other experts have shown the O-E System superior to others, and testimony has been added to our claim by many whose buildings are O-E heated. Send for Catalog "A."

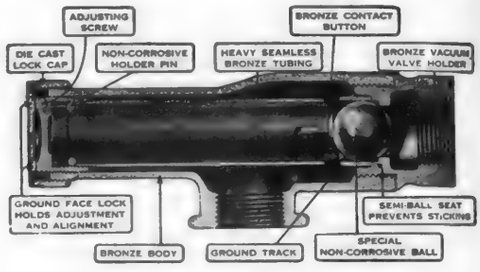
O-E Specialty Co., 12 Keefe Ave., Milwaukee, U. S. A.


TAPER ON STEM PREVENTS HANDLE SLIPPING
GUIDE ALSO HOUSING FOR SPRING
STEEL
MUSHROOM SHAPED DIAL VISIBLE AT A DISTANCE
HARD RUBBER
GROUND-IN PACKLESS FEATURE TESTED BY 40 TO 80 POUNDS AIR PRESSURE WHILE IMMERSED IN WATER
BRASS VALVE BODY TESTED BY 40 TO 80 POUNDS AIR PRESSURE WHILE IMMERSED IN WATER
FORGED BRASS
QUADRUPLE THREAD OPENS AND CLOSES IN ¼ TURN
SPECIAL COMPOSITION DISC
FORGED BRASS
NON-CORROSIVE DISC HOLDER CUP INSURES FREE MOVEMENT OF HOLDER

"O-E" Improved Perfect Packless Graduated Valve.

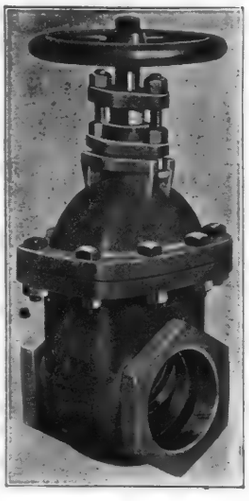


"O-E" Perfect Ball-Check Water Seal Union Elbow with Adjustable Air Vent.



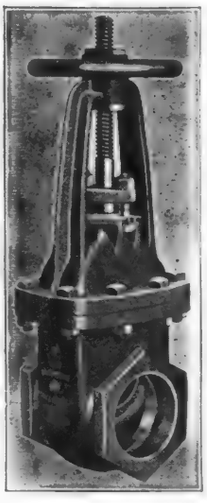
"O-E" Improved Air Exhauster and Vacuum Valve

IRON BODY GATE VALVES



SCREWED, FLANGED AND HUB END STYLES

NON-RISING STEM AND O. S. and Y. PATTERNS



ALSO MANUFACTURERS OF
Cast and Malleable Iron Fittings

Illinois Malleable Iron Company

1801 Diversey Parkway :-: :-: **Chicago, Ill.**

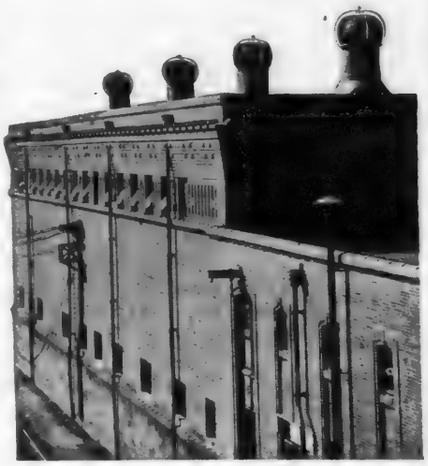
Where Performance Exceeded Our Own Ratings

To co-operate with a customer in making a test to substantiate the guaranteed air displacement capacity of Allen Air Turbine Ventilators is always welcomed by us.

We know that if they are satisfied with our catalog ratings they are surely going to be impressed with their test figures, for in many cases tests of actual installations have far exceeded our own ratings.

The figures below proved to the engineers of the New York Central Railroad Co. that the Allen Air-Turbines on one of their sub-stations are capable of doing more than we claim for them.

Diameter of Air-Turbine Used 48 Inches	AIR DISPLACEMENT—CU. FT. PER HOUR		
	Wind Velocity 4 Miles per Hour	Wind Velocity 6 Miles per Hour	Wind Velocity 8 Miles per Hour
Allen Air-Turbine Ventilator Co. Catalog Ratings.....	360,000		473,000
New York Central Railroad Company Test Figures.....		523,260	



Allen Air-Turbine Ventilators on Roof of New York Central Converter Sub-Station

Works Automatically—Constantly—Silently. No Operating Expense. Efficiency Guaranteed. Works in all Weather. Will Lift Moisture. Inexpensive.

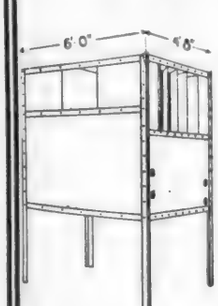
ALLEN AIR-TURBINE VENTILATOR CO.
DETROIT Eighth & Porter Sts. MICHIGAN

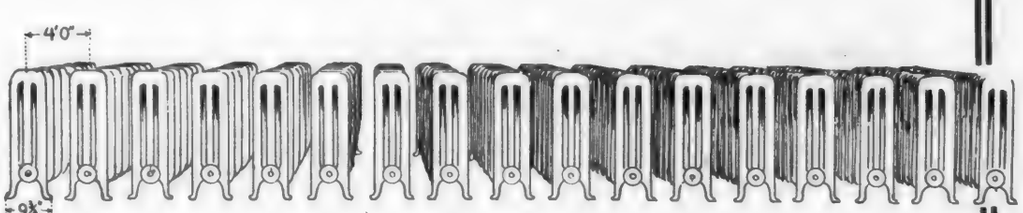
TWINFAN Unit Heaters

One Heater or Seventeen Radiators

THIS size Twinfan unit has a heating capacity equal to that of seventeen ordinary radiators. The Twinfan unit occupies 28 sq. ft. of floor space and the radiators require 55 sq. ft. That's a big argument for the Twinfan system that your customers will appreciate.

And from your own standpoint think how much less labor is involved in connecting the heater than the seventeen radiators. You know labor costs are the uncertain element in your estimates. Minimize this uncertainty by recommending the TWINFAN. Let us help you sell the next factory or public garage inquiry you get.





DWYER EQUIPMENT COMPANY
4534 W. NORTH AVE. CHICAGO, ILL.

PIONEERS IN 1888 — LEADERS TODAY

1888 Webster 1925

Thirty-seven Years of Steam Heating Progress

AT the close of 1924 the total number of installations of Webster Systems of Steam Heating exceeds 34,000. Finer buildings, of every type, almost everywhere are Webster-heated.

Pioneering in vacuum steam heating development and providing these 34,000 and more Webster Systems of Steam Heating has given us an unequalled experience. Ample laboratories devoted to continuous research have maintained Webster quality in equipment, engineering methods and service.

Recognition of Webster leadership by engineers, contractors and others in the heating industry has been the basis of our continued growth.

WARREN WEBSTER & COMPANY

Established 1888

46 U. S. BRANCHES

CAMDEN, N. J.

DARLING BROS., Ltd. MONTREAL, CANADA

OVER 4,000 WEBSTER SYSTEM INSTALLATIONS IN 1924

VAPOR MOUAT HEAT

Roberts Hotel, Muncie, Ind.

Nicol Sholer & Hoffman, Architects
Lafayette, Ind.

VAPOR MOUAT HEAT

Another modern hotel installs

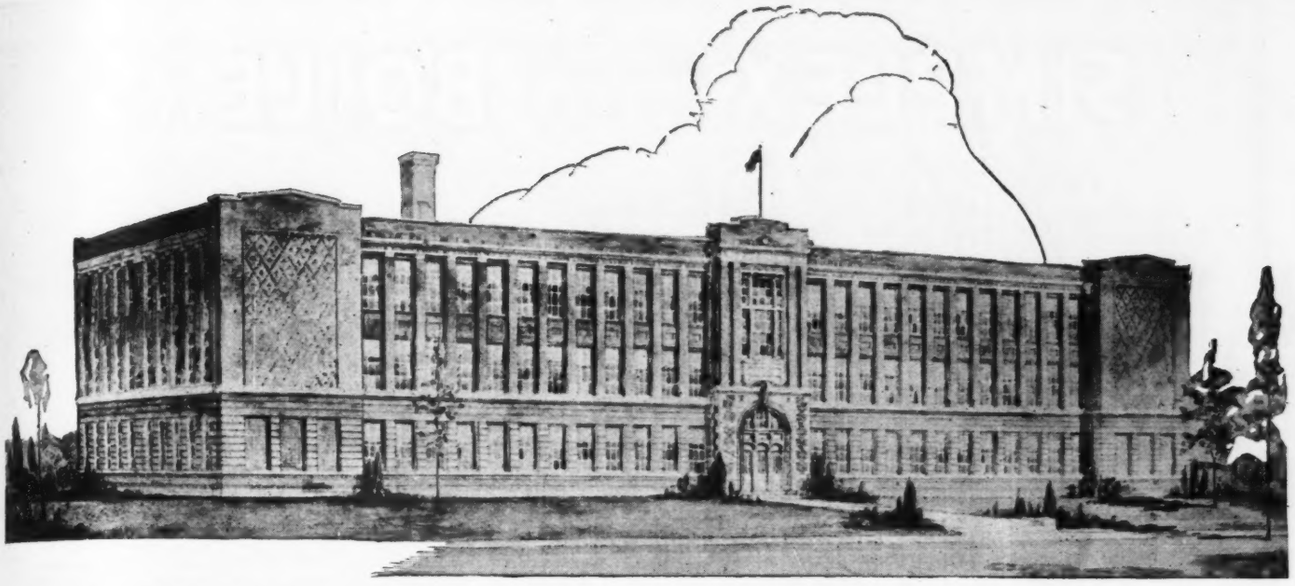
MOUAT VAPOR HEAT

The test of any heating system is a hotel. Modern hotels with their complicated service demand that which is most simple and efficient.

That demand is met when Mouat Vapor Heat is installed—the heating system that has positive heat control in each room without the use of vacuum pumps traps or thermostatic valves.

Only one-half to three ounces of pressure are necessary for operation

MOUAT VAPOR HEATING COMPANY
CLEVELAND, OHIO



Consolidated School, Tipton, Iowa

EQUIPPED WITH 41 UNIVENTS

THOMAS MCLENNAN & THOMAS, *Architects*

Des Moines, Iowa

Fifty Years from *Now*

UNIVENT (TRADE MARK)

VENTILATION

Time has no effect on fundamental principles. Natural laws are unchanging. Right is always right. Wrong is always wrong.

The Principle of the Univent is Right and will always be Right. The Univent today is the same in principle as the original Univent, and 50 years from today it will still be the same in principle. The only change that has occurred is the refinements that simplify and perfect the application of the principle.

Univent Ventilation—fresh heated air from the window—circulated in each room without draft—is the highest type of modern school ventilation. It will always be the highest type. The growing appreciation of the vital need for better ventilation in school means that 50 years from now nearly every school will be Univent Ventilated.

The Univent may be installed in new or old schools. Heating and Ventilating Engineers are invited to write for our special Engineer's Edition of "Univent Ventilation."

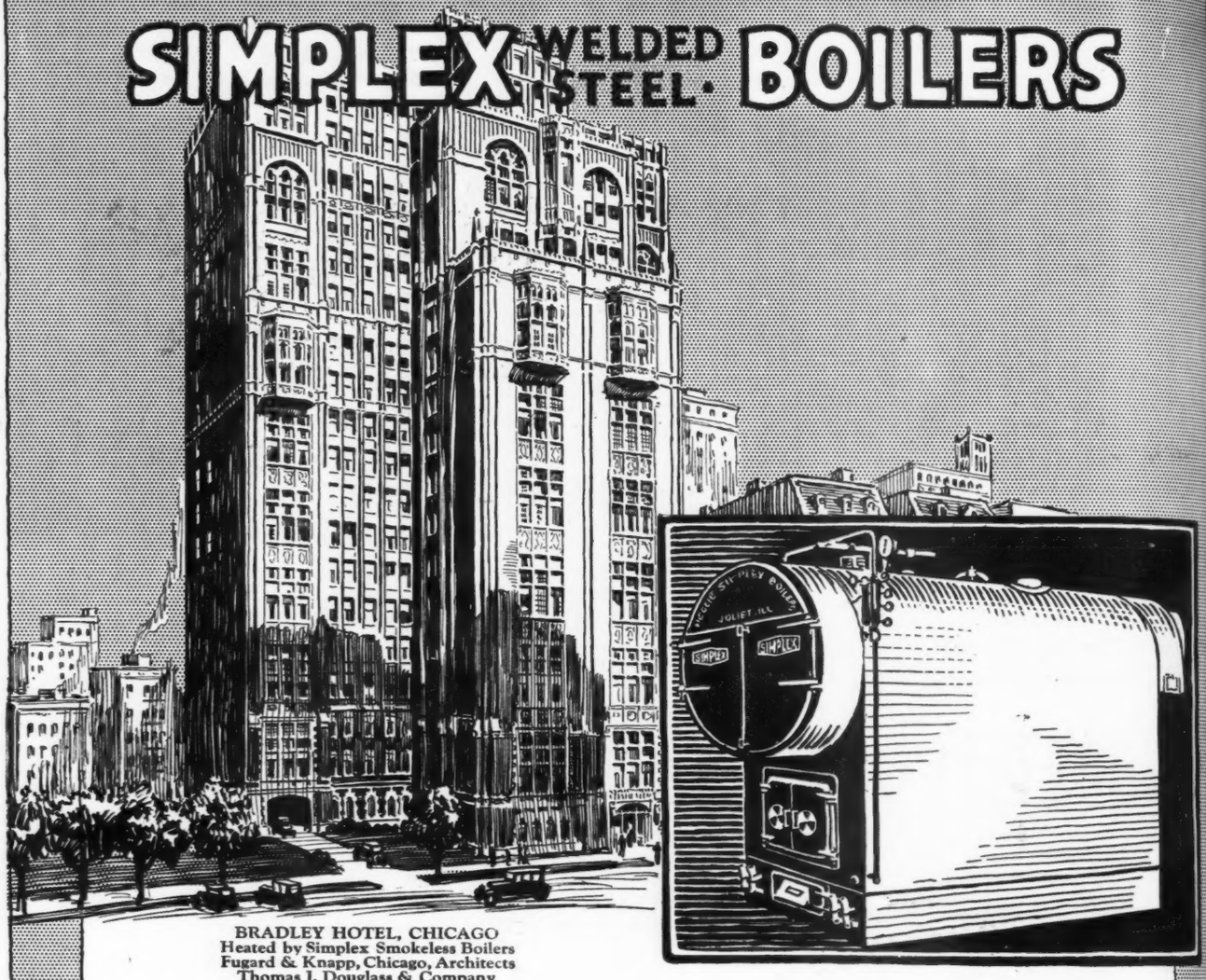
THE HERMAN NELSON CORPORATION *Moline, Ill.*

1970 Third Avenue

Branch Sales and Service Stations

BELFAST, ME.	SCRANTON	DETROIT	DES MOINES	ST. LOUIS	SALT LAKE CITY
BOSTON	PITTSBURGH	TOLEDO	MILWAUKEE	EMPORIA	SPOKANE
NEW YORK CITY	GRAND RAPIDS	INDIANAPOLIS	MINNEAPOLIS	OMAHA	PORTLAND
SYRACUSE	CLEVELAND	TORONTO	CHICAGO	KANSAS CITY	SEATTLE
PHILADELPHIA	COLUMBUS			DENVER	VANCOUVER

SIMPLEX WELDED STEEL BOILERS



BRADLEY HOTEL, CHICAGO
Heated by Simplex Smokeless Boilers
Fugard & Knapp, Chicago, Architects
Thomas J. Douglass & Company
Chicago, Contractors

A single *welded steel* unit

The water-jacket, completely surrounding double-pass tubes and firebox, has no pipe connections; it's electrically welded into one piece. Thus water circulates unimpeded and at a correct rate for maximum heat-absorption.

Length of gas-travel is greatest possible consistent with efficiency. Burns *any* fuel (including oil) with ¼ to ⅓ more effect, since the gases undergo exceptionally thorough combustion. Needs ⅓ less floor space; requires about half the usual firings; cleans easily from the front.

Specify Simplex Boilers and your client will boast of his heating plant.

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Contents for February, 1925

New Data on Radiator Finishes and Their Effect on Heat Transmission *William H. Severn* 51
Details of a Recent Investigation and a Comparison of the Results with Those of the Well-Known Allen Experiments.

Winnipeg's New District Heating System 54
How the Necessity for a Standby Power Plant Furnished the Opportunity for Its Operation as a Heating Station—Possible Effect of Powdered Fuel Combustion on the Use of Canada's Vast Lignite Resources.

Home-Study Course in Gravity Steam and Water Heating 57
Lesson No. 4—Heat Loss Computations—Rule-of-Thumb Methods.

Effective Temperature with Clothing *C. P. Yagloglou and W. Edw. Miller* 63
Equivalent Conditions of Temperature, Humidity and Air Movement, Determined with Individuals Normally Clothed.

Emotional Excitement and Its Effect on Temperature Rise in Exhaled Air *S. Homer Woodbridge* 66
Interesting Phenomena Observed in House of Representatives During Memorial Exercises for the late President Wilson.

The Insulation of Roofs to Prevent Heat Loss and Condensation 67

American Society of Heating and Ventilating Engineers 69
The Research Laboratory Goes On—Proceedings of Thirty-First Annual Meeting.
Death of Secretary Houghten's Father.
Organization of Past President's Club.
Illinois Chapter Hears Talk on Boiler Ratings.
New Officers of Western New York Chapter.
Colorado Chapter Elects New Officers.
Philadelphia Chapter Installs Officers.

Rating the Warm-Air Furnace *Professor A. C. Willard* 79
A Simplified, Approximate Method Based on Extensive Research and Adapted to Practical Use.

Central and District Heating Possibilities in Canada 82

Takes Issue with Statements on Warm-Air Furnace Operation 85

The Weather for December, 1924 86
New York, Boston, Pittsburgh, Chicago and St. Louis.

Correspondence 88
Flashing of Condensation in Return Pipes.
Whistling Noise in Gas Burners.
Heat Transmission from Pipe Coils for Various Sizes of Pipe and Heating Systems.
Effect of Room Partitions in Figuring Radiation.
Smaller Returns for Vapor Heating Systems.

Long-Range Weather Prophecies 89

Legal Decisions 90
No Lien for Furnishing Temporary Heat to Buildings Under Construction Under Illinois Statutes.
Interest in Contracts by Members of Council Awarding Them.

Labor Survey in Steamfitting Trade 90

An Elaborate Air Purifier and Humidifier for the Home 91

How to Heat Your Home *Samuel S. Wyer* 92
V—How to Burn Coke.

National Trade Extension Bureau 92
"Ask 'Em to Buy" Campaign.
T. E. B. Sales Campaign for 1925.

1925 to Equal 1924 as a Building Year 93

The State of Business *L. W. Alwyn-Schmidt* 95
Market Improvement Indicated—Manufacturers' Profit Margin Normal—Credit Situation Requires Attention.

Standard Heating and Ventilating Data Sheets 100
No. 49-B—(revised)—Boilers—Boiler Capacities.
No. 49-C—(revised)—Boilers—Boiler Capacities (Cont'd).
No. 49-D—Boilers—Boiler Capacities (Cont'd).
No. 49-E—Boilers—Boiler Capacities (Concld'd).

Engineers' Specification Index, Page 150

Advertisers' Index, Page 158

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